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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 104

THE FORAMINIFERA OF THE ATLANTIC OCEAN

Part 6. MILIOLIDAE, OPHTHALMIDIIDAE AND FISCHERINIDAE

BY

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INTRODUCTION

This paper is the sixth part of a work the intent of which is to describe and illustrate the Foraminifera of the Atlantic Ocean, especially those species which have occurred in the waters adjacent to the shores of the United States, including the whole of the Gulf of Mexico and the Caribbean Sea, that being the area in which most of the work of the vessels of the United States engaged in dredging work has been done. This part includes the families Miliolidae, Ophthalmidiidae, and Fischerinidae. For the most part these live in shallow warm waters and are not to be found so abundantly in the dredgings as in shallow-water collections near shore.

Joseph Augustine Cushman.

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THE FORAMINIFERA OF THE ATLANTIC OCEAN

MILIOLIDAE, OPHTHALMIDIIDAE, AND FISCHERINIDAE

By Joseph Augustine Cushman

Of Sharon, Massachusetts

INTRODUCTION

This sixth part of the work on the Atlantic Foraminifera deals with the Miliolidae, Ophthalmidiidae, and Fischerinidae, families closely allied to one another with imperforate tests. Since the earlier parts of this work were written, a new classification which has been in process for some years has been finished and published.[1] In order to have the earlier portions fit into the new classification, it is necessary to go over them in outline, and this is here done in the following pages. A table showing the relationships of the families as at present used is also given. The following two parts of this work will take up the remaining families so that all will be included in eight parts as originally planned.

The Classification of the Foraminifera here adopted is that which I have recently published.[1] In brief outline the early parts of the Atlantic Foraminifera Bulletin 104, United States National Museum, parts 1-5 are here reviewed and the position of the various genera and sometimes species is indicated in the new classification. In this way the earlier portions may be brought into line with the later ones by the student using them. Only those genera are mentioned whose species are included in the Atlantic work.

Family 1. ALLOGROMIIDAE

As the specimens of this family do not occur in the *Albatross* dredgings which form the chief source of material for this work, they are not included.

Family 2. ASTRORHIZIDAE

Test free, consisting of a central chamber from which radiate tubular channels to the exterior, either simple or branching; wall with a thin chitinous inner layer on all or part of which is agglutinated

[1] Cushman, Foraminifera, Their Classification and Economic Use, Special Publ. No. 1, Cushman Laboratory for Foraminiferal Research, 1928, pp. 1–401, pls. 1–59.

arenaceous material; apertures formed by the peripheral ends of the arms or by openings in the peripheral wall.

Genus ASTRORHIZA Sandahl, 1857

Bull. 104, pt. 1, pp. 7-14.

Genus RHABDAMMINA M. Sars, 1869

Bull. 104, pt. 1, pp. 14–22.

Genus CRITHIONINA Goës, 1894

Bull. 104, pt. 1, pp. 67–69.

Family 3. RHIZAMMINIDAE

Test consisting of a tubular chamber open at both ends; wall with a chitinous lining and exterior of agglutinated foreign material, arenaceous grains, sponge spicules or other foraminifera; apertures formed by the open ends of the tubes.

Genus MARSIPELLA Norman, 1878

Bull. 104, pt. 1, pp. 23–27.

Genus BATHYSIPHON M. Sars, 1872

Bull. 104, pt. 1, pp. 27–30.

Genus RHIZAMMINA H. B. Brady, 1879

Bull. 104, pt. 1, pp. 31, 32.

Family 4. SACCAMMINIDAE

Test free or attached, composed typically of a single chamber or occasionally with chambers of the same sort loosely united; wall lined with chitin, the exterior of agglutinated material of various sorts, sand grains, sponge spicules or other foraminiferal tests; aperture usually single, of various shapes.

Subfamily 1. PSAMMOSPHAERINAE

Test without a definite aperture.

Genus PSAMMOSPHAERA F. E. Schultze, 1875

Bull. 104, pt. 1, pp. 33–38.

Genus SOROSPHAERA H. B. Brady, 1879

Bull. 104, pt. 1, p. 39.

Genus STORTHOSPHAERA F. E. Schultze, 1875

Bull. 104, pt. 1, pp. 39, 40.

Subfamily 2. SACCAMMININAE

Test free, with a definite aperture; wall of firmly agglutinated sand or sponge spicules.

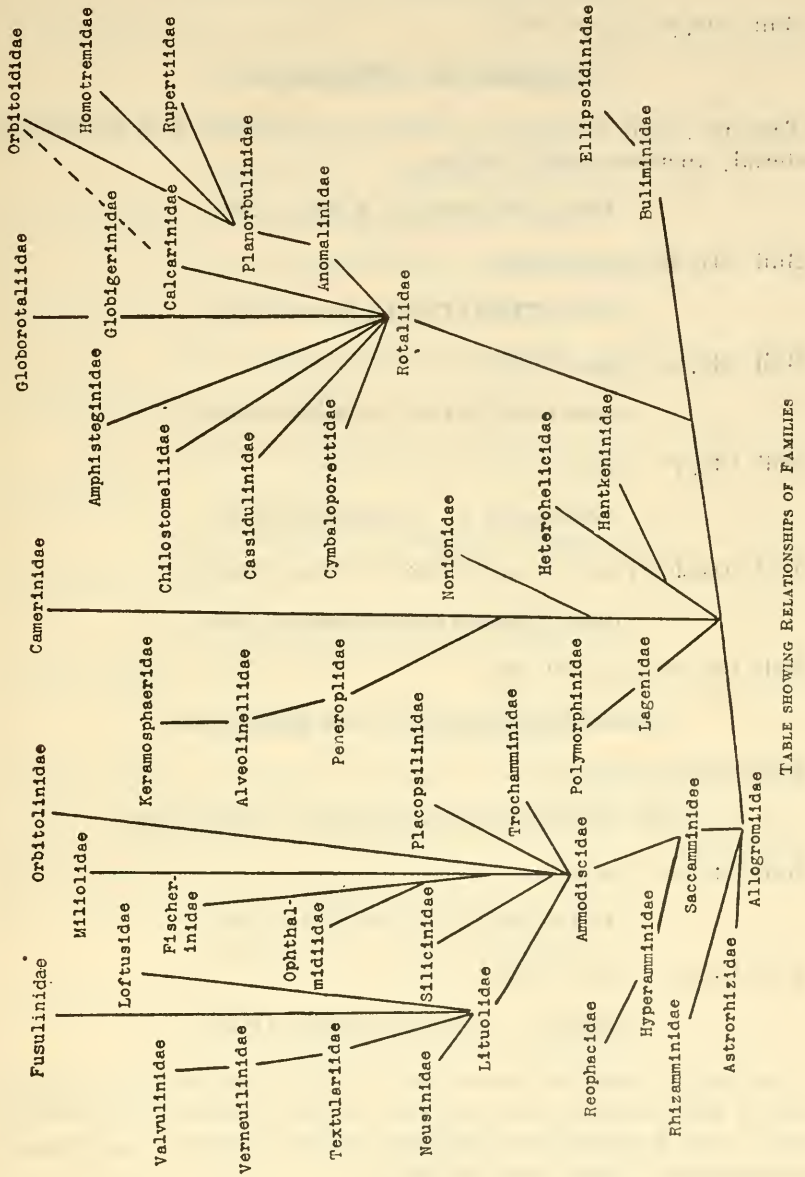

TABLE SHOWING RELATIONSHIPS OF FAMILIES

Genus SACCAMMINA M. Sars, 1869

Bull. 104, pt. 1, pp. 43–46.

Genus PROTEONINA Williamson, 1858

Bull. 104, pt. 1, pp. 46–51.

Genus LAGENAMMINA Rhumbler, 1911

Bull. 104, pt. 1, p. 51.

Genus THURAMMINA H. B. Brady, 1879

Bull. 104, pt. 1, pp. 70–73.

Subfamily 3. PELOSININAE

Test free; wall typically of matted spicules and fine amorphous material; aperture usually single.

Genus PELOSINA H. B. Brady, 1879

Bull. 104, pt. 1, pp. 53–56.

Genus TECHNITELLA Norman, 1878

Bull. 104, pt. 1, pp. 58–61.

Genus PILULINA W. B. Carpenter, 1870

Bull. 104, pt. 1, pp. 51, 52.

Subfamily 4. WEBBINELLINAE

Test attached; wall of agglutinated foreign material.

Genus WEBBINELLA Rhumbler, 1903

Bull. 104, pt. 1, pp. 61, 62.

Genus IRIDIA Heron-Allen and Earland, 1914

Bull. 104, pt. 1, p. 41.

Genus RHAPHIDOSCENE Vaughan Jennings, 1896

Bull. 104, pt. 1, p. 42.

Genus THOLOSINA Rhumbler, 1895

Bull. 104, pt. 1, pp. 63–65.

Family 5. HYPERAMMINIDAE

Test free or attached, consisting of a globular proloculum and a more or less elongate but not close-coiled, sometimes branching, portion, not divided into chambers; wall of various agglutinated materials with a basal layer of chitin.

Subfamily 1. HYPERAMMININAE

Test free, simple.

Genus HYPERAMMINA H. B. Brady, 1878

Bull. 104, pt. 1, pp. 73–78.

Genus JACULELLA H. B. Brady, 1879

Bull. 104, pt. 1, pp. 83–85.

Genus HIPPOCREPINA Parker, 1870

Bull. 104, pt. 1, p. 57.

Subfamily 2. DENDROPHRYINAE

Test attached, usually branching.

Genus SACCORHIZA Eimer and Fickert, 1899

Bull. 104, pt. 1, p. 81.

Genus DENDROPHYRA Str. Wright, 1861

Bull. 104, pt. 1, pp. 85, 86.

Genus HALIPHYSEMA Bowerbank, 1862

Bull. 104, pt. 1, pp. 86–88.

Genus PSAMMATODENDRON Norman, 1881

Bull. 104, pt. 1, p. 79.

Genus SYRINGAMMINA H. B. Brady, 1883

Bull. 104, pt. 1, p. 83.

Family 6. REOPHACIDAE

Test consisting of either an irregular or a generally rectilinear series of chambers, typically increasing in size as added, simple or labyrinthic; wall chitinous with usually an exterior of agglutinated material, sand grains, sponge spicules or the tests of other foraminifera; aperture usually terminal, simple or multiple.

Subfamily 1. ASCHEMONELLINAE

Chambers irregular.

Genus ASCHEMONELLA H. B. Brady, 1879

Bull. 104, pt. 2, pp. 2, 3.

Genus KALAMOPSIS de Folin, 1883

Bull. 104, pt. 1, p. 80.

Subfamily 2. REOPHACINAE

Chambers typically in a regular rectilinear series.

Genus REOPHAX Montfort, 1808

Bull. 104, pt. 2, pp. 5–25 (exclusive of *R. membranaceus* = *Nodellum*).

Genus HORMOSINA H. B. Brady, 1879

Bull. 104, pt. 2, pp. 26–32.

Genus HAPLOSTICHE Reuss, 1861

Bull. 104, pt. 2, pp. 33–35.

Genus NODELLUM Rhumbler, 1913

Bull. 104, pt. 2, p. 21 (*Reophax membranaceus* H. B. Brady).

Family 7. AMMODISCIDAE

Test composed of a globular proloculum and long undivided tubular second chamber, usually close coiled, at least in the young, planispiral, conical spiral or irregularly winding; wall of fine arenaceous material with much cement, usually of a yellowish or reddish brown color; aperture formed by the open end of the tubular chamber.

Subfamily 1. AMMODISCINAE

Test free.

Genus AMODISCUS Reuss, 1861

Bull. 104, pt. 1, p. 95.

Genus TURRITELLELLA Rhumbler, 1903

Bull. 104, pt. 1, pp. 101, 102.

Genus AMMODISCOIDES Cushman, 1909

Bull. 104, pt. 1, pp. 97, 98.

Genus GLOMOSPIRA Rzehak, 1888

Bull. 104, pt. 1, pp, 99, 100.

Genus LITUOTUBA Rhumbler, 1895

Bull. 104, pt. 2, pp. 58, 59.

Subfamily 2. TOLYPAMMININAE

Test attached.

Genus TOLYPAMMINA Rhumbler, 1895

Bull. 104, pt. 1, pp. 91–94 (*Girvanella*).

Genus AMMOLAGENA Eimer and Fickert, 1899

Bull. 104, pt. 1, p. 89.

Family 8. LITUOLIDAE

Test free, planispiral at least in the young, later portion in some genera uncoiled, divided into chambers, either simple or labyrinthic; wall arenaceous with varying proportions of cement in different genera and species, usually with a yellowish or reddish brown cement, the last-formed chamber in the adult often white; aperture simple or compound.

Subfamily 1. HAPLOPHRAGMIINAE

Test composed of simple chambers, not labyrinthic.

Genus TROCHAMMINOIDES Cushman, 1910

Bull. 104, pt. 2, p. 36.

Genus HAPLOPHRAGMOIDES Cushman, 1910

Bull. 104, pt. 2, pp. 37–49.

Genus CRIBROSTOMOIDES Cushman, 1910

Bull. 104, pt. 2, p. 51.

Genus AMMOBACULITES Cushman, 1910

Bull. 104, pt. 2, pp. 60–67.

Genus HAPLOPHRAGMIUM Reuss, 1860

Bull. 104, pt. 2, pp. 67, 68.

Subfamily 2. LITUOLINAE

Test composed of labyrinthic chambers.

Genus CYCLAMMINA H. B. Brady, 1876

Bull. 104, pt. 2, pp. 52–57.

Genus LITUOLA Lamarck, 1804

Bull. 104, pt. 2, p. 69.

Family 9. TEXTULARIIDAE

Test in the earliest stages, at least in primitive forms, planispiral, later in all but the most accelerated forms developing a biserial stage, final development taking various forms, usually becoming uniserial in the more specialized types; wall arenaceous, with a varying proportion of cement in different genera and species; aperture typically at the inner margin of the last-formed chamber in the biserial forms, becoming terminal and sometimes multiple in the uniserial forms.

Subfamily 1. SPIROPLECTAMMININAE

Test with the early chambers distinctly planispiral in both microspheric and megalospheric forms; later chambers biserial; wall arenaceous.

Genus SPIROPLECTAMMINA Cushman, 1927

Bull. 104, pt. 3, pp. 3–5 (*Spiroplecta*).

Subfamily 2. TEXTULARIINAE

Test typically biserial or becoming uniserial, usually free; chambers simple or labyrinthic; wall arenaceous, usually perforate; aperture simple or cribrate.

Genus TEXTULARIA Defrance, 1824

Bull. 104, pt. 3, pp. 5–22 (except *T. barrettii*, p. 20).

Genus TEXTULARIELLA Cushman, 1927

Bull. 104, pt. 3, p. 20 (*Textularia barrettii* Jones and Parker).

Genus CUNEOLINA d'Orbigny, 1839

Bull. 104, pt. 3, pp. 52–54.

Genus BIGENERINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 23–29 (except *B. pennatula* and *B. capreolus* = *Vulvulina*).

Genus VULVULINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 27, 28 (*Bigenerina pennatula* (Batsch) and *B. capreolus* d'Orbigny).

Family 10. VERNEUILINIDAE

Test, at least in the early stages, triserial, later biserial in some genera and in most specialized ones becoming uniserial; wall arenaceous, the amount of cement varying in different genera and species; aperture simple or multiple.

Genus VERNEUILINA d'Orbigny, 1840

Bull. 104, pt. 3, pp. 54–60 (except *V. spinulosa* = *Reussia*).

Genus TRITAXIA Reuss, 1860

Bull. 104, pt. 3, pp. 66, 67 (?).

Genus GAUDRYINA d'Orbigny, 1839

Bull. 104, pt. 3, pp. 67–78.

Genus TRITAXILINA Cushman, 1911

Bull. 104, pt. 3, p. 79.

Genus CLAVULINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 80–89.

Family 11. VALVULINIDAE

Test in the early stages triserial, later with a secondary spiral development, finally in some genera becoming annular; chambers simple or in the higher forms labyrinthic; aperture simple or cribrate.

Genus VALVULINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 61–64.

Family 12. FUSULINIDAE

(Fossil—Palaeozoic.)

Family 13. LOFTUSIIDAE

(Fossil—Eocene.)

Family 14. NEUSINIDAE

Genus BOTELLINA W. B. Carpenter, 1869

Bull. 104, pt. 2, p. 88.

Family 15. SILICINIDAE

(Fossil—Jurassic to Eocene.)

Family 16. MILIOLIDAE.—Family 17. OPHTHALMIDIIDAE.—Family 18. FISCHERINIDAE. (In this part—Part 6.)

Family 19. TROCHAMMINIDAE

Test in general trochoid, of numerous chambers, or irregular; wall arenaceous, with much cement, usually of yellowish or reddish brown color.

Subfamily 1. TROCHAMMININAE

Test trochoid, chambers in spiral whorls; aperture ventral.

Genus TROCHAMMINA Parker and Jones, 1860

Bull. 104, pt. 2, pp. 72–83.

Subfamily 2. GLOBOTEXTULARIINAE

Test irregularly spiral, the chambers globose; aperture in the open umbilical area.

Genus GLOBOTEXTULARIA Eimer and Fickert, 1899

Bull. 104, pt. 2, pp. 83, 84.

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Genus AMMOSPHAEROIDINA Cushman, 1910

Bull. 104, pt. 2, p. 87.

Genus AMMOCHILOSTOMA Eimer and Fickert, 1899

Bull. 104, pt. 2, pp. 84–86.

Family 20. PLACOPSILINIDAE

Test attached; chambers numerous and distinct, the early ones often coiled or trochoid, interior simple or labyrinthic; wall arenaceous; apertures of various forms.

Subfamily 1. PLACOPSILININAE

Chambers simple, not labyrinthic.

Genus PLACOPSILINA d'Orbigny, 1850

Bull. 104, pt. 2, pp. 70, 71.

Family 21. ORBITOLINIDAE

(Fossil—Palaeozoic to Eocene.)

Family 22. LAGENIDAE

Test vitreous, with a glassy luster; chambers simple, neither biserial, trochoid, nor irregularly spiral, planispiral, when coiled; wall calcareous with very fine perforations; aperture typically radiate but in a few genera simple, in the radiate apertured forms with a small chamberlet below the radiate aperture opening into the main chamber by a simple rounded orifice.

Subfamily 1. NODOSARIINAE

Test multilocular.

Genus ROBULUS Montfort, 1808

Genus LENTICULINA Lamarck, 1804

Genus PLANULARIA Defrance, 1825

Bull. 104, pt. 4, pp. 101–126. (Under these three genera should be placed the species under *Cristellaria* except those triangular forms which should be placed under *Saracenaria*.)

Genus MARGINULINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 127–132.

Genus DENTALINA d'Orbigny, 1826

Genus NODOSARIA Lamarck, 1812

Genus GLANDULINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 62–93. (Under these three genera are included the species recorded as *Nodosaria*.)

Genus SARACENARIA Defrance, 1824

Bull. 104, pt. 4, pp. 125–126 (*Cristellaria italica* and *C. latifrons*).

Genus LINGULINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 93–98.

Genus VAGINULINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 132–138.

Genus FRONDICULARIA Defrance, 1824

Bull. 104, pt. 4, pp. 139–145.

Subfamily 2. LAGENINAE

Test consisting of a single chamber; aperture typically radiate, but elliptical or rounded in many species.

Genus LAGENA Walker and Jacob, 1798

Bull. 104, pt. 4, pp. 3–61 (except such species as should be placed under *Ellipsolagena* and *Entosolenia*).

Family 23. POLYMORPHINIDAE

Test spiral or sigmoid in the earlier stages, later in some genera becoming biserial, uniserial, or irregularly branching; chambers simple, not labyrinthic; wall calcareous, very finely perforate; aperture radiate except in the more degenerate genera where there is a simple, rounded opening.

Subfamily 1. POLYMORPHININAE

Test with the chambers in a closed spiral or sigmoid series at least in the early stages, later becoming in some genera biserial or uniserial.

Genus GUTTULINA d'Orbigny, 1826

Genus PSEUDOPOLYMORPHINA Cushman and Ozawa, 1928

Genus PYRULINELLA Cushman and Ozawa, 1928

Genus POLYMORPHINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 145–159. (Under these genera should be placed the species recorded as *Polymorphina*.)

Subfamily 2. RAMULININAE

Test free or attached, chambers widely separated by stoloniferous connections.

Genus RAMULINA Rupert Jones, 1875

Bull. 104, pt. 4, p. 177.

Family 24. NONIONIDAE. — Family 25. CAMERINIDAE. — Family 26. PENEROPLIDAE.—Family 27. ALVEOLINELLIDAE. (To be included in Part 7 of this Bulletin.)

Family 28. KERAMOSPHAERIDAE

(Not known from the Atlantic.)

Family 29. HETEROHELICIDAE

Test in the more primitive forms planispiral in the young, later becoming biserial, in the more specialized genera the spiral and biserial stages reduced or wanting and the relationships shown only by other characters; wall calcareous, perforate, ornamentation in specialized genera bilaterally symmetrical; aperture when simple, usually large for the size of the test, without teeth, in some forms with an apertural neck and phialine lip.

Subfamily 1. HETEROHELICINAE

Test in the early stages distinctly planispiral, later chambers biserial; aperture large, at the inner margin of the chamber.

(Fossil—Cretaceous only.)

Subfamily 2. PAVONININAE

Test with the planispiral stage much reduced, the biserial stage of short duration and the adult with single chambers extending clear across the face of the test or even becoming completely annular.

Genus PAVONINA d'Orbigny, 1826

Bull. 104, pt. 2, p. 51.

Subfamily 3. GÜMBELININAE

Test in the early stages of the microspheric form planispiral, often skipped in the megalospheric form, followed by a biserial stage which may be continued or may be followed by globular chambers variously arranged.

(Fossil—Cretaceous and Eocene.)

Subfamily 4. BOLIVINITINAE

Test in the adult biserial, compressed; aperture in the median line, at the base of the inner margin.

Genus BOLIVINITA Cushman, 1927

Bull. 104, pt. 3, p. 44 (*Bolivina rhomboidalis* and *B. quadrilatera*).

Subfamily 5. SPIROPLECTINATINAE

Test elongate, early position clearly planispiral, later biserial or uniserial; wall calcareous, perforate.

(Not included in the Atlantic.)

Subfamily 6. PLECTOFRONDICULARINAE

Test in the microspheric form planispiral in the early stages, later biserial and then uniserial or in the higher forms starting as uniserial tests; ornamentation bilaterally symmetrical; aperture rounded or elliptical, terminal.

(No Atlantic species.)

Subfamily 7. EOUVIGERININAE

Test in the earliest stages biserial, later triserial or in the most specialized genera uniserial after the triserial stage or throughout.

(No Atlantic forms described.)

Family 30. HANTKENINIDAE

Test planispiral, at least in the young, involute; each chamber with a long acicular spine; wall calcareous, perforate or in some species vesicular on the exterior; aperture, a high arched opening often with basal lobes or divided.

(No Atlantic forms.)

Family 31. BULIMINIDAE

Test typically an elongate spiral, divided into chambers, in the specialized genera biserial or uniserial or even monothalamous; wall calcareous, perforate; aperture loop-like or rounded and terminal, usually with some sort of apertural tooth or spiral connected with the interior tubular siphons connecting the apertures.

Subfamily 1. TEREBRALININAE

Test in an elongate, close spiral; not divided into chambers; aperture rounded, subterminal.

(Fossil—Jurassic.)

Subfamily 2. TURRILININAE.

Test, an elongate close spiral, divided into chambers, usually more than three to a whorl, the lines of the spiral very distinct.

Genus BULIMINELLA Cushman, 1911

Bull. 104, pt. 3, pp. 108–113.

Genus BULIMINOIDES, Cushman, 1911

Bull. 104, pt. 3, p. 113.

Subfamily 3. BULIMININAE

Test spiral, usually triserial, becoming involute and finally in *Entosolenia* monothalamous; aperture, loop shaped, the larger end away from the inner margin (or in *Entosolenia* rounded) usually with a distinct tooth and internal tube connecting the chambers (or in *Entosolenia* free at the inner end).

Genus BULIMINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 90–108.

Genus ENTOSOLENIA Ehrenberg, 1848

Bull. 104, pt. 4. (Here should be included some of the species recorded under *Lagena*.)

Subfamily 4. VIRGULININAE

Test usually showing traces of its spiral origin in the twisted young, later biserial, and in the end forms uniserial.

Genus VIRGULINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 114–121.

Genus BOLIVINA d'Orbigny, 1839

Bull, 104, pt. 3, pp. 29–49 (except *B. rhomboidalis* and *B. quadrilatera* = *Bolivinita*).

Subfamily 5. REUSSIINAE

Test distinctly triserial, at least in the young of most forms, in specialized forms becoming uniserial; aperture in the simpler forms and in the young, elongate, in the uniserial forms and some of the triserial ones, cribrate.

Genus REUSSIA Schwager, 1877

Bull. 104, pt. 3, p. 60 (*Verneuilina spinulosa* Reuss).

Genus CHRYSALIDINELLA Schubert, 1907

Bull. 104, pt. 3, p. 65 (*Chrysalidina dimorpha* H. B. Brady).

Subfamily 6. UVIGERININAE

Test generally triserial, at least in the earlier stages, later in some forms uniserial or irregular; aperture typically terminal with a neck and phialine lip, and in some genera a spiral tooth and an internal twisted tube connecting the chambers.

Genus UVIGERINA d'Orbigny, 1826

Bull. 104, pt. 4, pp. 160–172 (except *U. angulosa* = *Angulogerina*).

Genus SIPHOGENERINA Schlumberger, 1883

Bull. 104, pt. 4, pp. 172–175.

Genus ANGULOGERINA Cushman, 1927

Bull. 104, pt. 4, p. 170 (*Uvigerina angulosa* Williamson).

Genus TRIFARINA Cushman, 1923

Bull. 104, pt. 4, p. 99.

Family 32. ELLIPSOIDINIDAE

Test with the wall calcareous, finely perforate, variously formed, the aperture usually narrow, elongate, curved in the outline of a semi-ellipse, a hollow tube or rod-like structure, sometimes in the form of a curved plate connecting the various chambers, similar in general to that found in the Buliminidae.

Genus PLEUROSTOMELLA Reuss, 1860

Bull. 104, pt. 3, pp. 49, 50.

Genus ELLIPSOLAGENA A. Silvestri, 1923

Bull. 104, pt. 4. (Here may be placed some of the species recorded under *Lagena*.)

Family 33. ROTALIIDAE.—Family 34. AMPHISTEGINIDAE.—Family 35. CALCARINIDAE.—Family 36. CYMBALOPORETTIDAE. (To be included in Part 8 of this Bulletin.)

Family 37. CASSIDULINIDAE

Test at least in the early stages, trochoid, later chambers in some genera alternating on the dorsal and ventral surfaces of the test or even uncoiling; wall calcareous, perforate; aperture in the early stages of the simpler genera at the margin of the ventral face of the chamber but projecting into the apertural face in a direction gradually becoming parallel to the periphery, elongate.

Subfamily 1. CERATOBULIMININAE

Test rotaliform throughout.

Subfamily 2. CASSIDULININAE

Test with the chambers alternating on the two sides of the plane of coiling.

Genus CASSIDULINA d'Orbigny, 1826

Bull. 104, pt. 3, pp. 122–132 (except *C. parkeriana* = *Cassidulinoides*).

Genus CASSIDULINOIDES Cushman, 1927

Bull. 104, pt. 3, p. 132 (*Cassidulina parkeriana* H. B. Brady).

Subfamily 3. EHRENBERGININAE

Test in the early stages as in *Cassidulina*, but the chambers soon becoming compressed in a plane at right angles to that of the early coiling and becoming uncoiled; aperture elongate, on the ventral side near the periphery.

Genus EHRENBERGINA Reuss, 1850

Bull. 104, pt. 3, pp. 133–137.

Family 38. CHILOSTOMELLIDAE

Test in the early stages of the simpler genera typically trochoid, the chambers all visible from the dorsal side, only those of the last-formed chamber visible from the ventral side, the chambers in later development variously arranged, typically planispiral and involute so that the early stages are completely covered; wall calcareous, perforate; aperture typically on the ventral side, at least in the early stages, in the planispiral forms becoming median.

Subfamily 1. ALLOMORPHININAE

Test in the adult with usually three chambers to a whorl, the chambers inflated and enlarging rapidly as added; aperture, an elongate, curved slit at the ventral border of the last-formed chamber.

Genus ALLOMORPHINA Reuss, 1850

Bull. 104, pt. 5, pp. 3, 4.

Subfamily 2. CHILOSTOMELLINAE

Test in the adult with two chambers making up a coil, the chambers inflated and enlarging rapidly as added; aperture variously modified, lateral or terminal.

Genus CHILOSTOMELLA Reuss, 1850

Bull. 104, pt. 5, pp. 1, 2.

Subfamily 3. SEABROOKIINAE

Test with two chambers forming a coil but entirely embracing on the ventral side, the aperture elliptical and terminal.

Genus SEABROOKIA H. B. Brady, 1890

Bull. 104, pt. 5, pp. 4, 5.

Subfamily 4. ALLOMORPHINELLINAE

Test with the later chambers planispiral, involute, chambers increasing rapidly in size as added; apertures becoming median.

Genus PULLENIA Parker and Jones, 1862

Bull. 104, pt. 5, pp. 40–42 (not *P. obliquiloculata* = *Pulleniatina*).

Family 39. GLOBIGERINIDAE

Test, at least in the early stages, trochoid, umbilicate; wall calcareous, rather coarsely perforate, usually with a cancellated surface, in well preserved specimens of the simpler genera with fine spines; aperture typically large but in the higher genera consisting of numerous small openings variously placed.

Subfamily 1. GLOBIGERININAE

Wall clothed with fine spines, typically trochoid but in some genera becoming planispiral; wall often cancellated, coarsely perforate.

Genus GLOBIGERINA d'Orbigny, 1826

Bull. 104, pt. 5, pp. 6–28 (except *G. rubra*, *G. conglobata*, *G. sacculifera* = *Globigerinoides; G. aequilateralis* = *Globigerinella* and *G. linneiana* = *Globotruncana*).

Genus GLOBIGERINOIDES Cushman, 1927

Bull. 104, pt. 5, pp. 15–21 (*Globigerina rubra* d'Orbigny, *G. conglobata* H. B. Brady, and *G. sacculifera* H. B. Brady).

Genus GLOBIGERINELLA Cushman, 1927

Bull. 104, pt. 5, p. 25 (*Globigerina aequilateralis* H. B. Brady).

Genus HASTIGERINA Wyville Thomson, 1876

Bull. 104, pt. 5, p. 33.

Subfamily 2. ORBULININAE

Test in the early stages trochoid like *Globigerina*, later developing a globular chamber entirely enclosing the earlier ones which may be later resorbed; wall often of several layers with perforations of various sizes, occasionally large openings, which are apparently accidental; exterior with fine spines.

Genus ORBULINA d'Orbigny, 1826

Bull. 104, pt. 5, pp. 28–32.

Subfamily 3. PULLENIATININAE

Test in the early stages trochoid and like *Globigerina*, later becoming involute and the later chambers covering the earlier ones; test without spines in the adult; wall coarsely porous.

Genus PULLENIATINA Cushman, 1927

Bull. 104, pt. 5, p. 43 (*Pullenia obliquiloculata* Parker and Jones).

Genus SPHAEROIDINELLA Cushman, 1927

Bull. 104, pt. 5, p. 38 (*Sphaeroidina dehiscens* Parker and Jones).

Subfamily 4. CANDEININAE

Test trochoid, in the young with the chambers roughened and spinose and with the aperture single as in *Globigerina*, in the adult the chambers smooth, without spines and the apertures formed by rows of circular or elliptical openings along the sutures.

Genus CANDEINA d'Orbigny, 1839

Bull. 104, pt. 5, pp. 34, 35.

Family 40. GLOBOROTALIIDAE.—Family 41. ANOMALINIDAE.—Family 42. PLANORBULINIDAE.—Family 43. RUPERTIIDAE.—Family 44. HOMOTREMIDAE. (To be included in Part 8 of this Bulletin.)

Family 45. ORBITOIDIDAE

(Fossil—Cretaceous to Miocene.)

SYSTEMATIC PART

Family 16. MILIOLIDAE

Test typically coiled about an elongate axis in various planes, at least in the microspheric young of even the specialized genera; chambers usually a half coil in length, simple in most genera, in a few with complex interiors, in the adult of many forms variously arranged; wall normally calcareous, imperforate, in some species of the more primitive genera with included sand grains on the exterior, under acid conditions developing a siliceous or chitinous test; aperture terminal, simple or cribrate, usually with a tooth.

The earliest appearance of this family is in the Carboniferous. There species of *Agathammina* first appear which are closely allied to *Glomospira* but are more regularly coiled about an elongate axis with the aperture normally near one end of the test. The basis of the test is calcareous and imperforate although the exterior may be covered with arenaceous material. In some of the species of *Agathammina*,

the general form of *Quinqueloculina* is already developed so that from one side four coils are visible and from the opposite side only three.

From *Quinqueloculina*, which has already developed the definite coiling in planes 144° apart and five chambers making a cycle, there are developed a number of genera. *Miliola* and *Schlumbergerina* develop a cribrate aperture, but keep the quinqueloculine form. A uniserial form follows the quinqueloculine stage in *Articulina*, *Tubinella*, and *Nubeculina*. In *Hauerina* and *Nummuloculina*, a planispiral development with several chambers to a coil takes place after the quinqueloculine young, the former with a cribrate aperture. A sigmoid development takes place in *Sigmoilina* and a planispiral development with but two chambers in a coil following the quinqueloculine stage in *Massilina* and *Spiroloculina*. Nearly all of these genera which are derived directly from *Quinqueloculina* develop species with an arenaceous outer layer above the imperforate calcareous inner layer of the test. The apertural tooth throughout this series is normally a simple one. The microspheric and megalospheric forms both show a quinqueloculine stage in the early development in this group.

In *Triloculina* there is added to the quinqueloculine stage a further development in which chambers are added in planes 120° apart and three chambers making a cycle. Species with an arenaceous exterior are developed and the apertural tooth normally has a bifid end. In the megalospheric form the quinqueloculine stage may be skipped even though it appears in the microspheric form of the same species. From *Triloculina* are developed *Trillina* with cribrate aperture and labyrinthic interiors, *Flintina* which becomes more or less planispiral, and *Ptychomiliola* in which the last-formed chambers uncoil and tend to become uniserial.

From *Triloculina* is added the further development, that of chambers added 180° from one another and two chambers making up the entire exterior of the test. The apertural tooth becomes broad and flat, and an arenaceous exterior is not normally developed in this series. In the microspheric form in section the early stages show quinqueloculine and triloculine stages before the "biloculine" development is taken on. In the megalospheric form the quinqueloculine stage is often skipped and in specimens with very large proloculum the triloculine stage may also be wanting.

From *Pyrgo* there are several genera developed. In *Fabularia*, the test becomes labyrinthic and the aperture cribrate. In *Flintia*, the test becomes spread out so that several chambers are visible from the exterior, the appearance being like *Spiroloculina*, but with the development from *Pyrgo*. In *Nevillina*, *Idalina*, *Periloculina*, and *Lacazina* there are highly specialized genera with the last-formed chamber

making up nearly or quite all of the exterior of the test. The aperture becomes very complex. The last three genera were especially developed in the Upper Cretaceous and did not live beyond that period.

Altogether there is a very definite series along a number of lines of development, the fossil record agreeing well with the stages in development shown in the individual. The microspheric form as is the case with other families of the foraminifera shows the most nearly complete stages in development.

Most of the genera and species are at the present day characteristic of warm shallow waters, very abundant about coral reefs in the tropics. Some of the genera such as *Pyrgo* and *Sigmoilina* have developed species which have become adapted to cold and deep water. In brackish or very deep water there are developed thin, chitinous or siliceous tests showing the added relationships of this family to the Silicinidae and to the arenaceous group with their chitinous lining.

A key is given to all the genera of the family regardless as to whether they are recent or not.

I. Test not divided into chambers, irregularly winding---------**Agathammina.**
II. Test chambered.
A. Test not reaching a triloculine stage.
1. Quinqueloculine throughout.
a. Aperture simple, with a simple tooth--------**Quinqueloculina.**
b. Aperture cribrate.
(1). Entirely calcareous, chambers completely involute.
Miliola.
(2). Exterior arenaceous, chambers not completely involute.
Schlumbergerina.
2. Later chambers of various shapes.
a. Later chambers two to a coil, laterally spreading.
(1). Quinqueloculine stage prominent, flattened chambers few.
Massilina.
(2). Quinqueloculine stage reduced, flattened chambers many.
Spiroloculina.
(3). Quinqueloculine stage prominent, later chambers sigmoid.
Sigmoilina.
b. Later chambers more than two in a coil.
(1). Aperture simple, with a broad tooth----**Nummoloculina.**
(2). Aperture cribrate----------**Hauerina.**
c. Later chambers elongate.
(1). Quinqueloculine stage prominent, uniserial chambers few.
Articulina.
(2). Quinqueloculine stage reduced, uniserial chambers many.
(*a*). Chambers indistinct, without a tooth----**Tubinella.**
(*b*). Chambers distinct, with a distinct tooth--**Nubeculina.**
B. Test reaching a triloculine stage but not a biloculine one.
1. Triloculine throughout.
a. Interior simple, aperture with a simple or bifid tooth--**Triloculina.**
b. Interior with secondary growth, aperture cribrate----**Trillina.**
2. Later stages in one plane, not uncoiled----------**Flintina.**
3. Later stages uncoiling and becoming uniserial-------**Ptychomiliola.**

II. Test chambered—Continued.
C. Test reaching a biloculine stage.
1. Adult biloculine.
a. Aperture simple with a broad tooth, interior simple.
(1). Completely involute throughout ..... Pyrgo.
(2). Later stages becoming evolute and spiroloculine .. Flintia.
b. Aperture cribrate, interior labyrinthic ..... Fabularia.
2. Adult exterior mostly formed by the last-formed chamber.
a. Penultimate chamber showing as a small basal area.
(1). Aperture of simple radiate form, chamber much elongate. Nevillina.
(2). Aperture complex, radiate in form, chamber broadly ovate ..... Idalina.
b. Penultimate chamber not visible.
(1). Test subglobular ..... Periloculina.
(2). Test strongly compressed ..... Lacazina.

Genus AGATHAMMINA Neumayr, 1887

Agathammina Neumayr (Genotype by designation, *Serpula pusilla* Geinitz). Sitz. Akad. Wiss. Wien, vol. 95, pt. 1, 1887, p. 171.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 145.
Serpula (part) Geinitz (not Linnaeus), Verst. Deutsch. Zechst. Roth., Heft 1, 1846, p. 6.
Trochammina (part) of Authors.

Test tubular, undivided, winding about an elongate axis; wall imperforate, calcareous, with arenaceous material at the surface; aperture formed by the open end of the tubular chamber.

Carboniferous to Jurassic.

This, as has been already noted, is the most primitive genus of the Miliolidae and shows clearly the connection of the Miliolidae with *Glomospira* of the Ammodiscidae.

Genus QUINQUELOCULINA d'Orbigny, 1826

Quinqueloculina d'Orbigny (Genotype by designation, *Serpula seminulum* Linnaeus). Ann. Sci. Nat., vol. 7, 1826, p. 301.—Cushman, Bull. 76, U. S. Nat. Mus., pt. 6, 1917, p. 42; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 146.
Serpula (part) Linnaeus, Syst. Nat., ed. 10, 1758, p. 786.
Adelosina d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303 (genotype, by designation, *A. striata* d'Orbigny).
Uniloculina d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 261 (genoholotype, *U. indica* d'Orbigny).
Miliolina (part) Williamson, Rec. Foram. Great Britain, 1858, p. 83 (and later authors).

Test with the coiling in five planes, the chambers a half coil in length and added successfully in planes 144° apart, five chambers completing a cycle, each chamber 72° from its adjacent one, but 144° from the immediately preceding one; wall imperforate, calcareous, often with; arenaceous material on the exterior and in deep or brackish water occasionally becoming siliceous; aperture usually with a simple tooth.

Carboniferous (?) to recent.

This genus has been recorded from the Carboniferous but it is probable that the records are based on species of *Agathammina* and not on true *Quinqueloculina*.

The groupings of species as given here are purely artificial and simply for convenience.

SPECIES WITH ARENACEOUS EXTERIOR

QUINQUELOCULINA AGGLUTINANS d'Orbigny

Plate 1, Figures 1 *a–c*

Quinqueloculina agglutinans d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 195, pl. 12, figs. 11–13.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 9, 10, text fig. 3; Publ. 311, Carnegie Instit. Washington, 1922, p. 63; Publ. 344, 1926, p. 81.

Test longer than broad; wall, at least on the exterior, composed of agglutinated sand-grains, forming a roughened surface; the periphery of the chambers broadly rounded; sutures fairly distinct; aperture slightly extended into a subcylindrical neck which, in well-preserved specimens, has 2 teeth extending in toward the center from opposite sides, each thickened toward the end, lip slightly everted, thin. Maximum length, 1.30 mm.; breadth, 0.85 mm.; thickness 0.65 mm.

D'Orbigny originally described this species from Jamaica and Cuba. It is generally common in rather shallow water in the general West Indian region where it is a well-defined species. The references to it elsewhere are many, but it is very doubtful if the species is at all so widely distributed as would seem from the numerous records. At the Tortugas the species occurred at all 20 of the stations from which material was recorded.

The broadly rounded periphery will distinguish this species from the other common arenaceous species of the West Indian region.

QUINQUELOCULINA BIDENTATA d'Orbigny

Plate 1, Figures 2 *a–c*

Quinqueloculina bidentata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 197, pl. 12, figs. 18–20.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 11, 12; Publ. 311, Carnegie Instit. Washington, 1922, p. 64; Publ. 342, 1924, p. 59, pl. 22, figs. 1, 2; Publ. 344, 1926, p. 81.

Test somewhat longer than broad; chambers distinct; periphery squarely truncate; wall composed of rather coarse sand-grains; apertural end projecting, with a slightly thickened lip; aperture with a thin tooth with a broad, bifid tip. Maximum length, 1.50 mm.; breadth, 1.05 mm.; thickness, 0.70 mm.

The type locality for this species is from shore sands of Cuba, given by d'Orbigny. The species has now been found well distributed

in the West Indian region but is not as common as *Quinqueloculina agglutinans*. The squarely truncate periphery will distinguish the species from the preceding.

QUINQUELOCULINA BRADYANA Cushman

Plate 1, Figures 3 *a–c*

Miliolina undosa H. B. Brady (not *Quinqueloculina undosa* Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 176, pl. 6, figs. 6–8.

Quinqueloculina bradyana Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 52, pl. 18, fig. 2; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 66; Publ. 311, Carnegie Instit. Washington, 1922, p. 67.

Test stout, usually but slightly longer than broad; chambers angular, more or less plicated laterally, the outer peripheral angle usually sinuous, the early ones very prominently so; apertural end rarely extended to any considerable length; aperture usually narrow, with a simple tooth.

Maximum length, 0.75 mm.; breadth, 0.50 mm.; thickness, 0.30 mm.

This species is not a common one in the western Atlantic. Specimens have been found in material from the north coast of Jamaica and at a few stations at the Tortugas.

The surface of this species often has finely agglutinated material.

QUINQUELOCULINA FUSCA H. B. Brady

Plate 1, Figures 4 *a–c*

Quinqueloculina agglutinans H. B. Brady (not d'Orbigny), Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865, pp. 87, 95.

Quinqueloculina fusca H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 286, pl. 11, fig. 2.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 442, pl. 84, fig. 6 *a–c*.

Miliolina fusca Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 6.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 325.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 62.—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 60, pl. 1, fig. 5.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 13, 1890, p. 163.—Chaster, First Rept. Southport Soc. Nat. Sci., 1890–91 (1892), p. 56.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 197.—Millett, Rec. Foram. Galway, 1908. p. 5.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 316; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 31; Trans. Zool. Soc. London, vol. 20, 1915, p. 576; Trans. Linn. Soc. London, vol. 11, 1916, p. 213; British Antarctic Exped., Zool., vol. 6, 1922, p. 69; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 608.

"Test composite, only slightly calcareous, usually formed of sand-grains imperfectly cemented upon or imbedded in a chitinous, almost membranous basis. Color variable, usually brown. Aperture large and conspicuous, equal in size to the transverse section of the terminal chamber, with which it corresponds in form. Length, one seventy-fifth of 1 inch."

This species seems to be common especially under brackish-water conditions about the British Isles although there are records for it also from the Indo-Pacific. Nothing referable to it has been noted in the western Atlantic.

It has been recorded about the British Isles at numerous stations in brackish water (Brady); Galway (Balkwill and Millett); off the Dublin coast (Balkwill and Wright); River Dee (Siddall); Jersey (Halkyard); Portree Bay (Robertson); off Southport (Chaster); shore sand, Bognor, Sussex (Earland); Selsey Bill, Sussex; Clare Island region, Ireland; west of Scotland (Heron-Allen and Earland).

The figures are from the type figures of Brady.

QUINQUELOCULINA SCLEROTICA Karrer

Plate 1, Figures 5 *a–d*

Quinqueloculina sclerotica Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abth. 1, 1868, p. 152, pl. 3, fig. 5.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 636; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 441.

Miliolina sclerotica Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 24, pl. 1, fig. 2.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 30; Trans. Linn. Soc. London, Zool., vol. 11, 1916, p. 213.

Test very similar to *Q. contorta*, but the exterior coated with arenaceous material, often of rather coarse grains.

This species has been recorded from the European side of the Atlantic, especially about the British Isles but not from the American side.

The figured specimen is from Balkwill and Millett.

SPECIES WITH SMOOTH SURFACE AND ROUNDED PERIPHERY

QUINQUELOCULINA SEMINULUM (Linnaeus)

Plate 2, Figures 1, 2

"Conchula minima arcte in se contorta, etc." Plancus, De Conchis min. not., 1739, p. 19, pl. 11, fig. 1 *A*, *B*, *C*.

"Tubulus marinus inregulariter intortus vermicularis" Gualtieri, Index Test., 1742, pl. 10, fig. *S*.

Serpula seminulum Linnaeus, Syst. Nat., ed. 12, 1767, p. 1264.

Quinqueloculina seminulum d' Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303.

Miliolina seminulum Williamson, Rec. Foram. Great Britain, 1858, p. 85, pl. 7, figs. 183–185.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1888, p. 157, pl. 5, fig. 6.

Test longer than wide, greatest width near the middle, chambers distinct, of nearly uniform diameter, periphery rounded; sutures distinct, very slightly depressed; wall smooth, polished; aperture large, with a simple tooth.

Length up to 1 millimeter or more in larger cold-water specimens.

This is a very common species according to the published records but many of the figures given do not fit the earlier ones of this

species. The typical form at least seems to be most frequent in cool waters. It is very abundant in fairly shallow waters of the northeastern coast of America and of the coast of Europe. In the tropical, West Indian waters, it does not seem to be present. As so many things are included under this name it does not seem wise to attempt to give a detailed synonymy.

The types are from the shore sands at Rimini where typical specimens similar to those figured here occur. It occurs also in the Pliocene of Italy.

QUINQUELOCULINA VULGARIS d'Orbigny

Plate 2, Figures 3 *a–c*

Quinqueloculina vulgaris d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 33.—Schlumberger, Mém. Soc. Zool. France, 1893, p. 207, text figs. 13, 14, pl. 2, figs. 65, 66.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 46, pl. 11, fig. 3.

Miliolina vulgaris Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 81.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 28; Trans. Zool. Soc. London, vol. 20, 1915, p. 569; Trans. Linn. Soc. London, Zool., vol. 11, 1916, p. 212.

Test short and stout, about as long as wide, in front view orbicular, chambers in transverse section roughly triangular, the periphery bluntly angled, sides straight or slightly convex; sutures distinct; wall smooth; apertural end not contracted or produced; aperture elongate, narrow, with a tooth bifid at the tip, in front view projecting slightly above the border of the aperture.

Length usually less than 1 millimeter.

This species is close to *Quinqueloculina seminulum* (Linnaeus) but is a shorter stouter species with a smooth surface and well-defined sutures.

It has been recorded from numerous stations on the eastern side of the Atlantic, but not from the West Indies or the eastern coast of the United States.

QUINQUELOCULINA (?) SUBROTUNDA (Montagu)

Plate 2, Figure 4

"Serpula subrotunda dorso elevato" Walker and Boys, Test. Min., 1784, p. 2, pl. 1, fig. 4.

Vermiculum subrotundum Montagu, Test. Brit., 1803, pt. 2, p. 521.

Quinqueloculina subrotunda d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302.—H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865, p. 94, pl. 12, fig. 2.

Miliolina subrotunda Fischer, Actes Soc. Linn. Bordeaux, vol. 27, 1870, p. 386.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 168, pl. 5, figs. 10, 11.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 26; Trans. Linn. Soc., Zool., vol. 11, 1916, p. 209.

Test generally circular in front view, compressed, periphery rounded; chambers quinqueloculine or in the adult spreading and more or less

in one plane, inflated; sutures distinct, slightly depressed; wall smooth; aperture usually with a simple tooth.

Diameter, 0.50 mm.; thickness, 0.25 mm.

This species is recorded from numerous stations, especially about the British Isles, but I have not found specimens which could be referred to it from the western Atlantic.

QUINQUELOCULINA DILATATA d'Orbigny

Plate 2, Figures 5 *a*, *b*

Quinqueloculina dilatata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 192, pl. 11, figs. 28–30.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 217, text figs. 29, 30; pl. 3, figs. 70–74; pl. 4, figs. 87–90.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 67, pl. 16, fig. 5; Publ. 311, Carnegie Instit. Washington, 1922, p. 69, pl. 12, fig. 2.

Test in front view broader than long; chambers compressed; periphery rounded; sutures distinct, depressed; chambers with rounded periphery, in the adult the last-formed chambers failing to make a complete coil; surface smooth; aperture elongate, oval, with a tooth some distance back from the aperture itself.

Length, 0.45 mm.; breadth, 0.40 mm.; thickness, 0.25 mm.

D'Orbigny first described this species from Cuba and St. Thomas. I have it from Jamaica and the Tortugas, but it does not appear to be anywhere common. There are records from the Mediterranean.

SPECIES WITH SMOOTH SURFACE AND ACUTELY ANGLED PERIPHERY

QUINQUELOCULINA LAMARCKIANA d'Orbigny

Plate 2, Figures 6 *a–c*

Quinqueloculina lamarckiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat Cuba, 1839, "Foraminifères," p. 189, pl. 11, figs. 14, 15.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 13, 14; Publ. 311, Carnegie Instit. Washington, 1922, p. 64; Publ. 342, 1924, p. 63; Publ. 344, 1926, p. 81.

Quinqueloculina auberiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 193, pl. 12, figs. 1–3.

Quinqueloculina cuvieriana H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 162, pl. 5, figs. 12 *a–c*.

Test nearly as broad as long; chambers distinct; sutures slightly depressed; chambers generally triangular in transverse section, the angles subacute but not carinate; wall smooth and shiny; apertural end of the chamber slightly extended, forming an elliptical neck without a definite lip, but with a narrow elongate tooth.

Maximum length, 1 mm.; breadth, 0.80 mm.; thickness, 0.50 mm.

D'Orbigny described this species from shore sands of Cuba and Jamaica, and *Q. auberiana* which is evidently the same is from Cuba

and Martinique. The species is well distributed in the general West Indian region and probably like so many West Indian species is found also in the Indo-Pacific. There are records for it from the British Isles under the name *auberiana*. Brady in the *Challenger* Report evidently confused this species with *Q. cuvieriana*.

In the West Indian collections these are two forms which may possibly be distinct. These both have a smooth surface but in one the peripheral angle is acute and the surface smooth and polished whereas in the other the peripheral angle is usually more blunt and the surface dull.

QUINQUELOCULINA CANDEIANA d'Orbigny

Plate 3, Figures 1 *a–c*

Quinqueloculina candeiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 170, pl. 12, figs. 24–26.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 65, pl. 13, fig. 1; Publ. 344, 1926, p. 81.

Test nearly twice as long as broad; chambers distinct from one another; sutures sharply marked; chambers triangular in transverse section, the periphery sharply keeled; wall smooth, shiny; aperture comparatively small, with a simple tooth, extending somewhat above the outline of the aperture.

Length, 0.70 mm.; breadth, 0.35 mm.; thickness, 0.25 mm.

This species is more elongate than *Q. lamarckiana*, and the neck is protuberant. It is now known from several localities in the West Indian region.

QUINQUELOCULINA COLLUMNOSA Cushman

Plate 3, Figures 2 *a–c*

Miliolina cuvieriana Heron-Allen and Earland (not d'Orbigny), Trans. Zool. Soc. London, vol. 20, 1915, p. 571, pl. 4, figs. 33–36.

Quinqueloculina collumnosa Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 65, pl. 10, fig. 10.

Test slightly longer than broad; chambers somewhat indistinctly marked from one another, the periphery angled and projecting, the last-formed chamber extending out beyond the outline of the test at both ends; chambers somewhat undulate; wall smooth, dull; apertural end much contracted, extended to form a narrow, cylindrical neck with a small, rounded aperture; lip indistinct.

Length, 1.10 mm.; breadth, 0.80 mm.; thickness, 0.60 mm.

Specimens of this species have a distinctive outline with the apertural end much contracted into a slender cylindrical neck. The form referred by Heron-Allen and Earland to *Q. cuvieriana* d'Orbigny is the same as this species which seems to have a West Indian and Indo-Pacific distribution in shallow water.

QUINQUELOCULINA STELLIGERA Schlumberger

Plate 3, Figures 3, 4

Quinqueloculina stelligera Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 210, pl. 2, figs. 58, 59, text fig. 17.—Martinotti, Atti Soc. Ital. Sci. Nat., vol. 59, 1920, p. 291, test figs. 82, 83.

Miliolina stelligera Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 14; vol. 54, No. 16, 1910, p. 5.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 31, pl. 1, figs. 14, 15; Trans. Linn. Soc. London, vol. 11, 1916, p. 215, pl. 39, figs. 28–31.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 7.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 121, pl. 1, figs. 7–10; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 609.

Test elongate, about two and one-half times as long as wide, apertural end slightly produced, basal end rounded; chambers definite, triangular in section, the periphery bluntly or even acutely angled, the sides slightly channeled; sutures not definitely depressed; wall smooth; aperture rounded, with a slight neck and simple tooth.

This species was originally described from the Gulf of Marseilles by Schlumberger. It is recorded by Martinotti from Tripoli; from Corsica by Heron-Allen and Earland; from the Island of Delos and the Bay of Palermo by Sidebottom. From about the British Isles it is recorded by Heron-Allen and Earland from the Clare Island region of Ireland and from off the coast of Scotland. I have not found the species in the western Atlantic.

The specimens figured by Heron-Allen and Earland and reproduced here are not very close to Schlumberger's figured specimens.

SPECIES WITH SMOOTH SURFACE AND TRUNCATE PERIPHERY

QUINQUELOCULINA POLYGONA d'Orbigny

Plate 3, Figures 5 *a–c*

Quinqueloculina polygona d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 198, pl. 12, figs. 21–23.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 66, pl. 16, figs. 3, 4; Publ. 311, Carnegie Instit. Washington, 1922, p. 68; Publ. 344, 1926, p. 82.

Test somewhat longer than broad; chambers distinct; sutures slightly depressed; each chamber polygonal in cross-section, the periphery usually concave, with a projecting carina at either angle; apertural end extending into a short, cylindrical neck, aperture circular with an everted lip, and a single bifid tooth; surface usually dull.

Length, 0.75 mm.; breadth, 0.25 mm.; thickness, 0.15 mm.

This is a well characterized and widely distributed species of the West Indian region, described by d'Orbigny from Jamaica and Cuba. *Q. polygona* was placed by Brady as a synonym of *Q. ferussacii* d'Orbigny but that is a very different species as may be seen by a study of the originals.

QUINQUELOCULINA CONTORTA d'Orbigny

Plate 3, Figures 6 *a–c*

Quinqueloculina contorta d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 298, pl. 20, figs. 4–6.

Miliolina contorta Brady, Journ. Roy. Micr. Soc., 1887, p. 881.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 30; Trans. Linn. Soc. London, Zool., vol. 11, 1916, p. 213.

Test somewhat longer than broad; chambers polygonal in transverse section, periphery flattened and sides flattened, or slightly concave, angles subacute; sutures distinct, slightly depressed; wall smooth, porcellanous throughout; aperture rounded, slightly projecting, with a simple tooth.

This species originally decribed by d'Orbigny from the Miocene of the Vienna Basin is recorded from the European side of the Atlantic about the British Isles, off the coasts of Scotland and Ireland as well as from the coast of France.

QUINQUELOCULINA TRICARINATA d'Orbigny

Plate 4, Figures 1 *a–c*

Quinqueloculina tricarinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 187, pl. 11, figs. 7–9, 11.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 68, pl. 16, figs. 11, 12; Publ. 311, Carnegie Instit. Washington, 1922, p. 67.

Test elongate, the last-formed chamber extending out beyond the rest of the test at either end; in young specimens the chambers have three distinct carinae, but in the adult specimens there is a more or less irregular condition, due to obliquely transverse costae dividing up that part of the test into irregular areas; apertural end extending out into a narrow, cylindrical neck, usually with a slight lip and a single tooth, which may become bifid at the end.

Length, 1 mm.; breadth, 0.75 mm.; thickness, 0.50 mm.

D'Orbigny's original specimens are from Cuba and Jamaica. The species is probably widely distributed in the West Indian region. The relationships to *Q. kerimbatica* (Heron-Allen and Earland) from the Indo-Pacific are marked.

SPECIES WITH THE SURFACE ORNAMENTED BY COSTAE OR STRIAE

QUINQUELOCULINA STRIATA d'Orbigny

Plate 4, Figures 2 *a–c*

Quinqueloculina striata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 4.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, mém. 3, 1882, p. 184, pl. 20 (28), figs. 10–12.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 67.

Miliolina striata Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 579, pl. 44, figs. 13–17.

The only records for this species in the region seem to be from a single Tortugas station No. 23, on the outer side of Loggerhead Key, inside the main reef.

The surface is very finely striate, appearing almost smooth with a low magnification.

QUINQUELOCULINA LAEVIGATA d'Orbigny

Plate 4, Figures 3 *a–c*

Quinqueloculina laevigata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 6; in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, 1839, vol. 2, pt. 2, "Foraminifères," p. 143, pl. 3, figs. 31–33.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 65, pl. 13, fig. 2.

Specimens similar to the one figured here occur in the West Indian region and may be referred to d'Orbigny's species. The surface is not entirely smooth but shows slight traces of longitudinal costae. The surface is smooth and polished, and the traces of costae are not at first apparent. They seem very close to d'Orbigny's *Q. laevigata*.

QUINQUELOCULINA FUNAFUTIENSIS (Chapman)

Plate 4, Figures 4 *a*, *b*

Miliolina funafutiensis Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 178, pl. 19, fig. 6; Proc. Zool. Soc. London, vol. 1, 1902, p. 231.—Heron-Allen and Earland (?), Trans. Zool. Soc. London, vol. 20, 1915, p. 566, pl. 42, figs. 21, 22.

Quinqueloculina funafutiensis Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 67, pl. 13, fig. 3.

A few specimens were found at the Tortugas which are evidently identical with the species described by Chapman from the lagoon at Funafuti in the Pacific. It is evidently an example of the occurrence of a widely distributed Indo-Pacific species in the West Indian region.

The specimens have an acutely angled periphery with a few oblique costae not highly developed.

QUINQUELOCULINA CRASSA d'Orbigny, var. SUBCUNEATA Cushman

Plate 5, Figures 1 *a–c*

Miliolina crassa Heron-Allen and Earland (part) (not d'Orbigny), Trans. Zool. Soc. London, vol. 20, 1915, p. 572, pl. 42, fig. 41 (not 37–40).

Quinqueloculina crassa d'Orbigny, var. *subcuneata* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 423, pl. 89, figs. 4 *a–c*; Publ. 342, Carnegie Instit. Washington, 1924, p. 62, pl. 23, fig. 7.

Quinqueloculina crassa Cushman (not d'Orbigny), Publ. 344, Carnegie Instit. Washington, 1926, p. 82.

Test similiar to the typical form in ornamentation but short and the chambers wedge-shaped, almost sharp at the peripheral angles.

The types are from the Philippines but the species is well distributed in the Indo-Pacific. In the West Indies the species occurs at Porto Rico and probably elsewhere.

QUINQUELOCULINA COSTATA d'Orbigny

Plate 3, Figures 7 *a–c*

Quinqueloculina costata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 3.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 63, pl. 6 (11), figs. 3*a*–5*c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 49, pl. 15, fig. 1; Publ. 311, Carnegie Instit. Washington, 1922, p. 66, pl. 11, fig. 5.
Miliolina costata Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 579, pl. 44, figs. 9–12.

The specimens from the West Indian region referred to this species are from the Tortugas. They are shorter and stouter than *Q. poeyana* and *Q. subpoeyana*.

QUINQUELOCULINA POEYANA d'Orbigny

Plate 5, Figures 2 *a–c*

Quinqueloculina poeyana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 191, pl. 11, figs. 25–27.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 67, pl. 16, figs. 7, 8; Publ. 311, Carnegie Instit. Washington, 1922, p. 66; Publ. 344, 1926, p. 81.

Test two to three times as long as broad; chambers distinct; sutures slightly depressed; periphery rounded; surface ornamented by numerous longitudinal costae, running from the base of the chamber to the apertural lip; apertural end slightly extended, very slightly, if at all, constricted, lip slight; aperture circular, with a single narrow tooth, somewhat slightly bifid at the tip.

Length, 0.60 mm.; breadth, 0.35 mm.; thickness, 0.23 mm.

This is one of the common West Indian species described by d'Orbigny from the shore sands of Cuba. It is known from Cuba, Porto Rico, Jamaica and the Tortugas. It is a more elongate species than *Q. costata* d'Orbigny, and may be distinguished from *Q. subpoeyana* by its closer form, much more even chambers and more regular costae.

The aperture as figured by d'Orbigny is much smaller than in the usual run of specimens.

QUINQUELOCULINA SUBPOEYANA Cushman

Plate 5, Figures 3 *a–c*

Quinqueloculina subpoeyana Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 66.

Test elongate, about two and one-half times as long as wide; chambers distinct; the apertural end projecting a considerable distance beyond the outline of the test; the peripheral border rounded; surface ornamented by numerous longitudinal costae which, instead of being uniform, are usually irregularly toothed throughout, giving a peculiar roughened appearance to the test; costae continued to the aperture, which is very slightly contracted, with a very thin lip, with a single tooth; surface dull.

Length, 0.60 mm.; breadth, 0.25 mm.; thickness, 0.15 mm.

There is a peculiar ragged appearance characteristic of this species. The chambers are not uniformly placed, the sutures more or less open and the costae often toothed and uneven. The species is a fairly common one in the West Indian region.

QUINQUELOCULINA DISPARILIS d'Orbigny

Plate 5, Figures 4 *a–c*

Quinqueloculina disparilis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 21.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 70 (212), pl. 2, figs. 55–57, text figs. 21, 22.

Test short and broad, periphery broadly rounded or somewhat truncate, the outer side of the chamber with longitudinal costae, the sides almost smooth, with fine striae; aperture not produced, with a somewhat rounded lip and simple tooth.

Length, 0.60 mm.; breadth, 0.35 mm.; thickness, 0.25 mm.

Schlumberger has recorded this species from the Mediterranean. It is somewhat near *Q. undulata* d'Orbigny, but *Q. disparilis* may be distinguished by the more flattened periphery and the somewhat straight or even concave sides which are finely striate. The figured specimens are from off Plymouth, England. It is related to *Q. bicornis* (Walker and Jacob).

QUINQUELOCULINA FERUSSACII d'Orbigny

This species has been recorded from about the British Isles but the specimens differ somewhat from d'Orbigny's model which has an elongate neck. Heron-Allen and Earland have recorded it from the North Sea, from about the Shetland Islands, off the coast of Scotland and from the Clare Island region of Ireland. They note that Williamson recorded it under the name *Miliolina bicornis*, var. *angulata*. I have not had specimens from the western Atlantic that could be referred to this species.

QUINQUELOCULINA BICORNIS (Walker and Jacob)

Plate 5, Figures 5–7; Plate 6, Figures 1, 2

Serpula bicornis Walker and Jacob, in Kanmacher's ed., Adam's Essays Micr., 1798, p. 633, pl. 14, fig. 2.

Miliolina bicornis Williamson, Rec. Foram. Gt. Britain, 1858, p. 87, pl. 7, figs. 190–194.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 171, pl. 6, figs. 9, 11, 12.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 6.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 324.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 62 (list).—(?) H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 214, pl. 40, fig. 25.—Chaster, First Rep't Southport Soc. Nat. Sci., 1890-91 (1892), p. 56.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 464.—De Amicis, Boll. Soc. Geol. Ital., vol. 12, fasc. 3, 1893, p. 32.—Woodward, The Observer, vol. 4, 1893, p. 76.—Goës, Kongl. Svensk.

Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 113, pl. 21, figs. 860–861*e*.—Chapman, Proc. Zool. Soc. London, 1895, p. 10.—Jones, Foram. Crag., pt. 2, 1895, p. 122, pl. 3, figs. 41, 42.—A. Silvestri, Atti. Accad. Sci. Acireale, vol. 7, 1895–96, p. 37.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 14, pl. 4, figs. 13, 14.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 196.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 313.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 5.—Heron-Allen and Earland, vol. 31, pt. 64, 1913, p. 32, pl. 2, figs. 5, 6; Trans. Linn. Soc. London, vol. 11, ser. 2, 1916, p. 214; Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 122; Trans. Zool. Soc. London, vol. 22, 1926, p. 69 (list).

Quinqueloculina bicornis H. B. Brady, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 472 (table); Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 94; Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 49.—Terquem, Ess. Anim. Plage Dunkerque, pt. 1, 1875, p. 39, pl. 6, figs. 6 *a–c*.—Kiar, Rep't Norwegian Fish and Mar. Invest., vol. 1, No. 7, 1900, p. 28.

Test quinqueloculine, slightly longer than broad, periphery broadly rounded; chambers distinct, somewhat contorted, and sinuous; sutures distinct only slightly depressed; wall costate especially on the peripheral portion of each chamber, sides partially smooth; aperature elongate, more or less quadrate in the adult, only slightly projecting, the edges with a slight rim and a single simple tooth.

Length up to 1 mm.; breadth up to 0.70 mm.; thickness up to 0.50 mm.

This species seems to be very common in the Eastern Atlantic about the British Isles, off the coast of Europe and in the Mediterranean. There are numerous records of its occurrence elsewhere but the specimens are evidently not the same. For this reason numerous references are left out and only those given which it seems refer to the species originally described by Walker and Jacob.

The species is close to *Quinqueloculina undulata* d'Orbigny as figured by Schlumberger.

Variety *angulata* Williamson (pl. 6, figs. 3, 4) is a form in which the peripheral angles of the chambers are much thickened, each forming a rounded costa. In a form called var. *elegans* by Williamson (pl. 6, fig. 5) the periphery is very rounded.

QUINQUELOCULINA SEMINUDA Reuss

Plate 6, Figures 6 *a–c*

Heron-Allen and Earland[2] record this species from the Clare Island region of Ireland.

"This species, in which the peripheral margin of the chambers is decorated with a varying number of longitudinal striae, is generally distributed over the area (23 stations), but is never very abundant. The strength of the peripheral marking is very variable, in some cases

[2] Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 27.

being limited to one or two keels, whereas in others they cover more than half the face of the chamber. In some instances there is a tendency for the costae to run transversely from the marginal edge toward the middle of the chamber, where they gradually disappear." Earland records the species from the shore sands of Bognor, Sussex, and Heron-Allen and Earland from stations off the west of Scotland.

Reuss originally described the species from the Oligocene of Germany.

QUINQUELOCULINA PULCHELLA d'Orbigny

Plate 6, Figures 7, 8

Quinqueloculina pulchella d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303, No. 42.—H. B. Brady, Trans. Linn. Soc., vol. 24, 1864, p. 466, pl. 48, fig. 4.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon. 19, 1866, p. 13, pl. 4, fig. 3.—Terquem, Ess. Anim. Plage Dunkerque, pt. 3, 1881, p. 134, pl. 17, figs. 15, 16.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 29.—Fornasini, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 10, 1902, p. 24, ser. 6, vol. 2, 1905, p. 69, pl. 4, fig. 11.

Miliolina pulchella H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 174, pl. 3, figs. 10–13; pl. 6, figs. 13, 14.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 325.—Walther, Mitth. Zool. Sta. Neapel, vol. 8, pt. 2, 1888, p. 384, pl. 20, fig. 10.—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 61.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 189.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 114, pl. 21, figs. 862–864.—Jones, Pal. Soc. Mon. 19, pt. 2, 1895, p. 123, pl. 4, fig. 3; pl. 6, fig. 3.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 301, pl. 46, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1898, p. 509.—Sidebottom, Mem. Proc. Manchester Lit. Phil. Soc., vol. 48, No. 5, 1904, p. 15, pl. 4, fig. 15.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 197.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 314.—Sidebottom, Mem. Proc. Manchester Lit. Phil. Soc., vol. 54, No. 16, 1910, p. 6.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 33; Trans. Zool. Soc. London, vol. 20, 1915, p. 578; Trans. Linn. Soc. London, vol. 11, 1916, p. 214.

The figure given (pl. 6, fig. 8) is that of Fornasini from the tracing of the original d'Orbigny figure. It shows a very coarsely costate form, of somewhat irregular contour not unlike the material referred by many writers to this species. The records include very many regions in the present oceans and the Pliocene of England. It is not common on the coasts of America.

QUINQUELOCULINA cf. Q. KERIMBATICA Heron-Allen and Earland, var. PHILIPPINENSIS Cushman

Plate 7, Figures 1*a–c*

The figured specimen already recorded from the Tortugas region may be referred to the Philippine variety of the species described by Heron-Allen and Earland from the Kerimba Archipelago. The sides are generally smooth and unornamented but the periphery is irregular reticulate.

QUINQUELOCULINA PARKERI (H. B. Brady), var. OCCIDENTALIS Cushman

Quinqueloculina parkeri (H. B. Brady), var. *occidentalis* Cushman, Proc. U. S. Nat., Mus., vol. 59, 1921, p. 69; Publ. 311, Carnegie Instit. Washington, 1922, p. 68, pl. 12, fig. 3.

Test differing from the typical in the great number of fine, transverse, or slightly oblique ridges or crenulations, and the tendency for the chambers to become squarely truncate or even tricarinate.

This variety was originally described from the north coast of Jamaica, and occurs in the Tortugas collections. The typical form of the species so abundant in the Indo-Pacific does not seem to be present in the tropical Atlantic.

QUINQUELOCULINA PYGMAEA Reuss

Heron-Allen and Earland refer a single specimen from the Clare Island region of Ireland to this species.[3]

Genus MILIOLA Lamarck, 1804

Miliola (part) Lamarck (Genotype, by designation, *Miliola saxorum* Lamarck), Ann. Mus., vol. 5, 1804, p. 349.

Quinqueloculina (part) d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301.

Pentellina Munier-Chalmas and Schlumberger (genotype by designation, *P. heberti* Schlumberger)? Bull. Soc. Géol. France, ser. 4, vol. 5, 1905, p. 116.

Test in its structure similar to *Quinqueloculina* but the aperture cribrate.

Eocene.

Apparently this genus with its cribrate aperture became extinct in the Eocene. It is known from the Eocene both of Europe and America.

Genus SCHLUMBERGERINA Munier-Chalmas, 1882

Schlumbergerina Munier-Chalmas, Genoholotype, *Schlumbergerina areniphora* Munier-Chalmas, Bull. Soc. Géol. France, ser. 3, vol. 10, 1882, p. 424.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 148.

Miliolina (part) of authors.

Massilina (part) of authors.

Test typically quinqueloculine, the chambers narrowing so that frequently more than five chambers may be visible from the exterior; wall calcareous, imperforate, the exterior thickly coated with sand grains; aperture cribrate.

Late Tertiary and Recent.

The young of some of the species with arenaceous exterior frequently assigned to *Massilina* are close to this. The *Miliolina alveoliniformis* H. B. Brady described in 1879 is probably the same as Munier-Chalmas' species and belongs here. This species is often abundant in shallow-water tropical collections.

[3] Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 29.

Although the largest specimens of this genus are found in the Indo-Pacific, there is a smaller form which is evidently the same in the West Indian region and the genus also occurs fossil in the late Tertiary.

SCHLUMBERGERINA ALVEOLINIFORMIS (H. B. Brady)

Miliolina alveoliniformis H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 268; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 181, pl. 8, figs. 15–20.—Egger, Abhandl. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p. 232, pl. 2, figs. 17–19.—Woodward, The Observer, vol. 4, 1893, p. 76.—Millett, Journ. Roy. Micr. Soc., 1898, p. 510.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 177; vol. 30, 1910, p. 398.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 581.

Quinqueloculina alveoliniformis Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 43; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 443; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64; Publ. 311, Carnegie Instit. Washington, 1922, p. 64; Publ. 342, 1924, p. 58, pl. 21, fig. 8; Publ. 344, 1926, p. 81.

Test elongate, fusiform, composed of numerous chambers long and narrow, five normally visible from the exterior in the early stages, more in the adult; wall in young specimens thin and porcellanous, in adults covered with sand grains; aperture composed of numerous pores or radiate, typically cribrate.

Length of Indo-Pacific specimens up to 3 millimeters or more; of the West Indian variety usually not more than 1 millimeter.

The species is typical of shallow-water, coral-reef conditions.

The West Indian variety is apparently distinct, of smaller size and the chambers not so narrow, showing but five chambers on the exterior. It may be known as variety *occidentalis* Cushman, new variety (pl. 7, fig. 2).

Genus MASSILINA Schlumberger, 1893

Massilina Schlumberger (Genotype, by designation, *Quinqueloculina secans* d'Orbigny), Mém. Soc. Zool. France, 1893, p. 218.—Cushman, Special Publ. No. 1, Cushman, Lab. Foram. Res., 1928, p. 149.

Quinqueloculina (part) d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303.

Miliolina (part) of Authors.

Test with the early chambers quinqueloculine, later ones added on opposite sides in a single plane, the quinqueloculine stage present in both megalospheric and microspheric forms; aperture simple, with a bifid tooth.

Cretaceous to Recent (probably older).

This genus has developed from *Quinqueloculina* by the addition of the chambers in a single plane. It may be distinguished from *Spiroloculina* which is a more specialized genus having most of the characters in the microspheric form in a single plane and normally all of these in the megalospheric form in one plane.

MASSILINA SECANS d'Orbigny

Plate 7, Figures 3, 4

Quinqueloculina secans d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303, No. 43, Modeles, No. 96.—Bronn, Lethaea Geognostica, ed. 2, 1837, p. 1146, pl. 42, figs. 32 *a–c*.—Roemer, Neues Jahrb., 1838, p. 393, pl. 3, fig. 77.—Parker, Jones, and Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 34, pl. 1, fig. 10; ser. 4, vol. 8, 1871, p. 250, pl. 8, fig. 14.—H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 94.—Karrer, in von Drasche, Frag. Geol. Luzon, 1878, p. 88, pl. 5, fig. 7.—Bütschli, in Bronn, Klassen und Ordnungen Thierreichs, 1880, p. 189, pl. 4, fig. 11.—Basset, Ann. Soc. Sci. Charente-Inf., 1884 (1885), p. 163, fig.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 28.

Miliolina secans H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 167, pl. 6, figs. 1, 2.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 6.—Balkwill and Wright, Trans Roy. Irish Acad., vol. 28, Sci., 1885, p. 324.—Sherborn and Chapman, Journ. Roy. Micr. Soc., ser. 2, vol. 6, 1886, p. 742, pl. 14, fig. 4.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 3.—Chaster, First Rep't Southport Soc. Nat. Hist., 1890–91 (1892), p. 55.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 13, 1890, p. 163.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 237, pl. 2, figs. 59, 60.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 112, pl. 20, figs. 856–856*g*.—A. Silvestri, Atti Accad. Sci. Acireale, vol. 7, 1896, p. 17.

Massilina secans Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 218, pl. 4, figs. 82, 83, text figs. 31–33.—Fornasini, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 8, 1900, p. 10, figs. 10–13; ser. 5, vol. 10, 1902, p. 25.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 18.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 197.—Millett, Rec. Foram. Galway, 1908, p. 5.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 317.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 6.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 34; Trans. Zool. Soc. London, vol. 20, 1915, p. 582, pl. 44, figs. 24–27; Trans. Linn. Soc. London, vol. 11, ser. 2, 1916, p. 215.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 15, 16, 59, text figs. 17–20.—Martinotti, Atti Soc. Ital. Sci. Nat., vol. 59, 1920, p. 310, text figs. 122, 123.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 122; Journ. Roy. Micr. Soc., 1924, p. 133.

Vermiculum disciforme Macgillivray, Hist. Moll. Anim. Aberdeen, 1843, p. 319.

Miliolina seminulum (Linnaeus), var. *disciformis* Williamson, Rec. Foram. Gt. Britain, 1858, p. 86, pl. 7, figs. 188, 189.

Test in the early stages quinqueloculine, later with the chambers added in one plane, in side view rounded, nearly as broad as long, in end view narrow; periphery rounded or acute, sometimes keeled; chambers distinct, usually four or five visible on each side; sutures distinct, depressed; wall smooth; aperture elongate, usually with a simple tooth.

Length up to 1.5 mm.; breadth, 1.30 mm.; thickness, 0.35–0.50 mm.

This is a very common species in the material from off the coasts of western Europe and in the Mediterranean. It evidently extends into the Indo-Pacific but does not seem to be present in the western Atlantic, although Whiteaves recorded it from the Gulf of St. Lawrence; but the record without confirmation is to be questioned.

MASSILINA SECANS d'Orbigny, var. TENUISTRIATA Earland

Massilina secans d'Orbigny, var. *tenuistriata* Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 198, pl. 11, fig. 5.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 317; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 34; Trans. Zool. Soc. London, vol. 20, 1915, p. 582, pl. 44, figs. 28–31.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 445.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 122.

Variety with the entire surface of the test covered with fine longitudinal striae roughly parallel with the periphery but varying in coarseness in different specimens.

This variety is found on the eastern side of the Atlantic and in the Mediterranean and Indo-Pacific but is not known from the western Atlantic.

The localities include: shore sand, Bognor, Sussex, England (Earland); Selsey Bill, Sussex; Clare Island region of Ireland; Corsica; Kerimba Archipelago (Heron-Allen and Earland), and the Philippines (Cushman).

MASSILINA CRENATA (Karrer)

Plate 7, Figure 5

Spiroloculina crenata Karrer, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 135, pl. 1, fig. 9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 156, pl. 10, figs. 24–26.

Massilina crenata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 57, pl. 20, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 445; Publ. 311, Carnegie Instit. Washington, 1922, p. 69, pl. 11, fig. 6; Publ. 342, 1924, p. 66, pl. 25, fig. 4.

Test in its early development quinqueloculine, adult chambers in a single plane, in front view subelliptical, nearly as broad as long, compressed; chambers long and narrow, margin crenulate, due to the regular contractions or plications of the chamber in the adult; aperture rounded.

Length, 0.65 mm.; breadth, 0.50 mm.; thickness, 0.20 mm.

This is one of the species that is widely distributed in the Indo-Pacific but only appears in the Atlantic in the West Indian region. The only specimens are from the Tortugas region where the species occurred at three stations.

MASSILINA INAEQUALIS Cushman

Plate 7, Figures 6 *a–c*

Massilina inaequalis Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 72, pl. 17, figs. 12, 13.

Test much elongate, in the adult spiroloculine, from one side very much excavate, the other nearly plane, early chambers quinqueloculine, later ones spiroloculine, chambers very elongate, irregularly quadrate in transverse section, the peripheral side broader than the inner ones, one of the sides angled, the other straight; surface polished, shiny, but with numerous fine, linear depressions breaking the evenness of the surface; aperture rounded, apertural end of the test somewhat projecting; color glistening white.

Length, 1.5 mm.; breadth, 0.65 mm.; thickness, 0.30 mm.

This species was originally described from the north coast of Jamaica at Montego Bay where it occurred at several stations. It has not occurred elsewhere.

MASSILINA ALVEOLINIFORMIS Millett

Massilina alveoliniformis Millett, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5–7.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 584, pl. 45, fig. 15.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 69; Publ. 342, 1924, p. 64.

Spiroloculina asperula H. B. Brady (not Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 13, 14 (11?).—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 72.

Massilina asperula Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 447.

Test much compressed, nearly circular; early chambers quinqueloculine, later ones in a single plane, periphery rounded, chambers distinct; wall of sand grains with a porcellanous lining to the chambers; aperture very slightly exserted.

Length up to 1 mm.; breadth, 0.90 mm.; thickness, 0.25 mm.

This species is rather widely distributed in the Indo-Pacific but in the Atlantic appears only in the West Indian region. It may be more common in the West Indies than the records seem to indicate but the only known localities are three stations in the Tortugas region.

MASSILINA ANNECTENS Schlumberger

Massilina annectens Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 220, pl. 3, figs. 77–79, text figs. 35–37.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 18, pl. 5, figs. 2–4.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 34, pl. 1, figs. 9–11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 57, pl. 20, figs. 3*a–c*.—Martinotti, Atti Soc. Ital. Sci. Nat., vol. 59, 1920, p. 320, text fig. 148.—Cushman, Publ. 342, Carnegie Instit. Washington, 1924, p. 66.

The only Atlantic record for this species is that of Heron-Allen and Earland from a single station in the Clare Island region of Ireland. The other records are from the Mediterranean and Indo-Pacific.

The species is apparently just taking on its *Massilina* stage as only the last chambers are in a single plane. The chambers are angled with a broad, often concave, peripheral face.

Genus SPIROLOCULINA d'Orbigny, 1826

Spiroloculina D'ORBIGNY (Genotype, by designation, *Spiroloculina depressa* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 298.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol., 9, 1884, p. 147.—CHAPMAN, The Foraminifera, 1902, p. 89.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 149.

Miliola (part) LAMARCK, Ann. Mus., vol. 5, 1805, p. 352 (and later authors)

Test with the early chambers in the microspheric form quinqueloculine, the later ones in a single plane, chambers a half coil in length, in the megalospheric form all the chambers usually in one plane; apertural end usually with a neck and lip, simple, with a simple or bifid tooth.

Permian (?) Cretaceous to Recent.

This is a more specialized genus than *Massilina*, and the character of having chambers in a single plane is taken on very early even in the microspheric form. There are a number of species referred to *Spiroloculina* which belong elsewhere and it is probable that the actual history of the restricted genus begins in the Cretaceous.

SPIROLOCULINA GRATELOUPI d'Orbigny

Plate 8, Figures 1 *a–b*

Spiroloculina grateloupi D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 298.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 52, pl. 5, figs. 5, 6.—WIESNER, Arch. Prot., vol. 25, 1912, p. 208.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 31, pl. 4, figs. 4, 5; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 634; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 396, pl. 78, figs. 4 *a*, *b*; pl. 100, fig. 3; text figs. 17, 18; Publ. 311, Carnegie Instit. Washington, 1922, p. 59; Publ. 342, 1924, p. 56, pl. 20, figs. 3, 4; Publ. 344, 1926, p. 80.

Spiroloculina excavata H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 151, pl. 9, figs. 5, 6.

Test elongate, broadest in the center, tapering toward either end; chambers rapidly thickening as added, in end view the periphery much the broadest portion of the test, central portion deeply excavated; periphery of the chambers in end view much convex, especially in the central portion, the edges broadly rounded; chambers evenly curved, the final chamber somewhat projecting, both at the base and at the apertural ends, the latter having a decided neck with a phialine lip, the aperture itself rounded and with either a single tooth with a bifid end, the two projections forming a concave extremity, or in some cases a pair of such bifid teeth opposite one another; surface of the test dull, somewhat roughened.

Length, 1.25 mm.; breadth, 0.60 mm.; thickness, 0.25 mm.

This is typically a tropical species and best developed in the Indo-Pacific. The species, however, occurs widely distributed in the West Indian region, although specimens rarely exceed 1 millimeter in length and are not so deeply excavated as those of the Indo-Pacific.

SPIROLOCULINA PLANULATA (Lamarck)

Plate 8, Figures 2–5

Miliolites planulata Lamarck, Ann. Mus., vol. 5, 1805, p. 352, No. 4.

Spiroloculina planulata Macdonald, Ann. Mag. Nat. Hist., ser. 2, vol. 20, 1857, p. 153, pl. 6, fig. 28.—H. B. Brady, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 472 (table).—Jones, Parker, and H. B. Brady, Pal. Soc. Mon. 19, pt. 1, 1866, p. 15, pl. 3, figs. 37, 38.—H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 93.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 148, pl. 9, figs. 11 *a*, *b*.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 323.—Siddall, Proc. Lit. Philos. Soc. Liverpool, 1886, p. 62 (list).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 214, pl. 40, figs. 14, 15.—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 59.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 13, 1890, p. 163.—Chaster, First Rep't Southport Soc. Nat. Sci., 1890–91 (1892), p. 55.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 463.—De Amicis, Boll. Soc. Geol. Ital., vol. 12, fasc. 3, 1893, p. 19.—Woodward, The Observer, vol. 4, 1893, p. 76.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 107, pl. 18, figs. 836–836c.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon. 19, pt. 2, 1895, p. 103, pl. 3, figs. 37, 38, woodcut fig. 1.—A. Silvestri, Atti Accad. Sci. Acireale, vol. 7, 1896, p. 11.—Flint, Ann. Rep't U. S. Nat. Mus., 1897 (1899), p. 297, pl. 42, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1898, p. 264.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 29.—Wright, Irish Nat., vol. 9, 1900, p. 52.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 5.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 192.—Millett, Rec. Foram. Galway, 1908, p. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 119.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 2.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 302; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 23; Trans. Zool. Soc. London, vol. 20, 1915, p. 555; Trans. Linn. Soc. London, vol. 11, ser. 2, 1916, p. 207; Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 115.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 60.—Heron-Allen and Earland, British Antarctic Exped., Zoology, vol. 6, 1922, p. 63; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 603.—Chapman, New Zealand Geol. Surv., Pal. Bull. No. 11, 1926, p. 25.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 22, pt. 1, 1926, p. 68 (list).

Test irregularly elliptical; periphery concave, especially in the last-formed chambers, initial end of the chamber projecting considerably beyond the aperture of the previously formed one, the apertural end very slightly, if at all, projecting, side view concave; sutures distinct; surface matt; aperture with a slight lip and an elongate tooth, slightly bifid at the tip.

Length, 1.10 mm.; breadth, 0.90 mm.; thickness, 0.40 to 0.50 mm.

There are many records for this species from the European coasts, especially from about the British Isles. The records from the western Atlantic are few. The species evidently occurs fossil also in the late Tertiary. It is recorded from the Mediterranean and the

Indo-Pacific, but its characters do not always seem constant in this wide range, so possibly more than one species may be present.

Figures are given of both West Indian and European specimens.

SPIROLOCULINA ORNATA d'Orbigny

Plate 8, Figures 6 *a–c*

Spiroloculina ornata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 167, pl. 12, figs. 7, 7*a*.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64; Publ. 311, Carnegie Instit. Washington, 1922, p. 60, pl. 10, fig. 9.

Test elongate, compressed, concave in side view, the apertural end projecting to a considerable distance beyond the rest of the test; the last-formed chamber, and sometimes the one before, ornamented with a secondary costa, running from near the apertural end backward near the inner angle of the chamber; aperture quadrangular, with a single narrow tooth; surface smooth, shining.

Length, 1 mm.; breadth, 0.45 mm.; thickness, 0.10 mm.

This species was described by d'Orbigny from the shore sands of Cuba. It has been found in material from Jamaica and the Tortugas, and probably has a wider range in the West Indian region. It is a very thin species with concave periphery.

SPIROLOCULINA EXIMIA Cushman

Plate 8, Figures 7 *a*, *b*

Spiroloculina eximia Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 61, pl. 11, fig. 2; Publ. 342, 1924, p. 56, pl. 21, fig. 2.

Test elongate, elliptical, periphery convex, the opposite faces concave, ends of the chamber projecting; sutures fairly distinct, the outer angle of each chamber projecting above the inner portion of the adjacent next-formed chamber; wall with a granular, dull surface; apertural end with a projecting cylindrical neck, circular, with a single, very thin, slightly bifid tooth.

Length, 0.60 mm.; breadth, 0.35 mm.; thickness, 0.18 mm.

This species described originally from the West Indian region in the Tortugas collections has also been found at Samoa. It is to be suspected therefore that it will be eventually found to have a wide range in both the West Indian region and in the Indo-Pacific.

The surface is peculiar being coarsely granular and dull.

SPIROLOCULINA CADUCA Cushman

Plate 9, Figures 1, 2

Spiroloculina caduca Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 61, pl. 11, figs. 3, 4.

Test broadly elliptical, much compressed, the apertural end extended; chambers of the adult with a sharp translucent keel, usually somewhat lobulated; sutures slightly depressed, surface of

the chambers with irregular raised costae, more or less oblique in position; aperture at the end of the cylindrical neck, rounded, with a simple tooth; surface smooth, shining, but the wall very thin and brittle.

Length, 0.85 mm.; breadth, 0.60 mm.; thickness, 0.10 mm.

This peculiar keeled species is known only from the Tortugas region, but is to be looked for elsewhere in the West Indies.

SPIROLOCULINA ANTILLARUM d'Orbigny

Plate 9, Figure 3

Spiroloculina antillarum D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 166, pl. 9, figs, 3, 4.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 155, pl. 10, figs. 21 *a*, *b*.—CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 407, pl. 81, figs. 4 *a*, *b;* pl. 83, fig. 4?; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 63, pl. 14, figs. 14, 15; Publ. 311, Carnegie Instit. Washington, 1922, p. 61; Publ. 342, 1924, p. 55, pl. 20, fig. 1.

Test elongate, elliptical; chambers nearly circular in cross-section; surface ornamented by numerous longitudinal costae, often slightly oblique, both ends of the chamber projecting and the intermediate portions thus left either filled by a plate of clear material or occasionally open; apertural end projecting and forming a cylindrical neck with a slight lip and a single tooth, sometimes bifid at the tip.

Length, 0.95 mm.; breadth, 0.45 mm.; thickness, 0.15 mm.

This species was originally described by d'Orbigny from shore sands of Cuba. It is widely distributed and common in the whole West Indian region and also in the Indo-Pacific. Brady took the name of *Spiroloculina grata* Terquem for this species and it has been undoubtedly recorded many times under this name, but rarely figured. As the species is one of shallow water coral-reef conditions probably it is safe to accept most of the records of *S. grata* from such habitats as really *S. antillarum* d'Orbigny.

The following variety very often is found with the typical form of the species.

SPIROLOCULINA ANTILLARUM d'Orbigny, var. ANGULATA Cushman

Plate 9, Figures 4 *a*, *b*

Spiroloculina grata H. B. BRADY (part) (not Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 10, figs. 22, 23.

Spiroloculina grata TERQUEM, var. *angulata* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 36, pl. 7, fig. 5.

Spiroloculina antillarum D'ORBIGNY, var. *angulata* CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 408, pl. 81, figs. 5 *a*, *b*; Publ. 311, Carnegie Instit. Washington, 1922, p. 62; Publ. 342, 1924, p. 55, pl. 20, fig. 2; Publ. 344, 1926, p. 80.

Variety differing from the typical in the angular form of the chamber instead of cylindrical.

This variety is widely distributed in the West Indian region and also in the Indo-Pacific, usually occurring with the typical form of the species.

SPIROLOCULINA ARENATA Cushman

Plate 9, Figures 5 *a*, *b*

Spiroloculina arenata CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 63, pl. 14, fig. 17; Publ. 311, Carnegie Instit. Washington, 1922, p. 62; Publ. 344, 1926, p. 80.

Test compressed; chambers in a single plane, each much greater in diameter at the initial end, gradually narrowing to the aperture, both ends projecting beyond the ends of the preceding chamber; apertural end produced into a rounded neck, periphery broadly rounded; sutures deep and distinct; wall of sand-grains rather coarse for the size of the test; aperture rounded.

Length, 0.75 mm.; breadth, 0.30 mm.; thickness, 0.12 mm.

This species originally described from the north coast of Jamaica at Montego Bay has since been recorded from the Tortugas region and from Porto Rico. It is probably widely distributed in the West Indian region, and is one of the common species although of small size.

SPIROLOCULINA LIMBATA d'Orbigny

Plate 9, Figures 6, 7

The flattened forms of *Spiroloculina* have been greatly confused as have most of the early species named by d'Orbigny. A study of original material from the type localities of Dax, Bordeaux, Castel Arquato, and elsewhere has given much data as to what the types of these species really are. The type specimens of *S. limbata* are from Castel Arquato, Italy, in the Pliocene. Abundant material from that locality has shown that *S. limbata* is very well figured by d'Orbigny in the "planches inédites" as given later by Fornasini.

The sides are much excavated, the periphery broadly rounded and the sides keeled. Such specimens occur off the coasts of Europe in the Atlantic and Mediterranean, and to such material the specific name *S. limbata* d'Orbigny should be applied. No material of the western Atlantic can be referred to the species.

This form has usually been erroneously referred by many authors to *S. depressa* d'Orbigny.

SPIROLOCULINA DEPRESSA d'Orbigny

Plate 9, Figures 8, 9

This is another of the species that has been greatly confused. The localities given by d'Orbigny are the Mediterranean and fossil at Castel Arquato. The original figure shows a very much flattened species with the sides parallel and the periphery slightly concave or truncate with the chambers slightly thickened at the peripheral edges.

Such specimens occur in my material from Castel Arquato and may be taken as topotypes.

Material referred to this species occurs off the coasts of the British Isles and in the Mediterranean as well as in the Indo-Pacific. There is such confusion in the literature between this and *S. limbata* that references to the literature can be made intelligently only after a study of the original specimens in each case.

Williamson figures specimens as var. *rotundata* and var. *cymbium* which are reproduced here. The former (pl. 9, fig. 10) may possibly be referred to *S. nitida* d'Orbigny, a species that has been recorded from the British Isles and the coasts of France.

SPIROLOCULINA DORSATA Reuss

Heron-Allen and Earland record this species as new to Great Britain [4] but do not give figures. They note its resemblance to and probable confusion with *S. limbata* d'Orbigny.

Genus NUMMOLOCULINA Steinmann, 1881

Nummoloculina Steinmann (Genoholotype, *Biloculina contraria* d'Orbigny) Neues Jahrb., 1881, p. 31.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 149.

Biloculina (part) d'Orbigny Foram. Foss. Bass. Tert. Vienne, 1846, p. 266.

Planispirina (part) H. B. Brady (not Seguenza), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 195.

Test with the earliest chambers quinqueloculine, later ones in a single plane, several making up a coil; aperture rounded with a flat, semicircular tooth.

Jurassic to Recent.

In this genus an entirely new structure is developed from a quinqueloculine young. The chambers are developed in one plane but instead of a half coil in length they become progressively shorter so that as many as six chambers make up the last complete coil.

NUMMOLOCULINA CONTRARIA (d'Orbigny)

Plate 10, Figures 1 *a*, *b*

Biloculina contraria d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 266, pl. 16, figs. 4–6.—H. B. Brady, Trans. Linn. Soc., vol. 24, 1864, p. 466, pl. 48, fig. 2.—Reuss, Sitz. Akad. Wiss. Wien, vol. 55, abt. 1, 1867, p. 70, pl. 1, fig. 10.—Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abt. 1, 1868, p. 131.

Nummoloculina contraria Steinmann, Neues Jahrb., 1881, p. 31, pl. 2, figs. 1–7.

Planispirina contraria H. B. Brady, Proc. Roy. Soc. Edinburgh, 1882, p. 713; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 195, pl. 11, figs. 10, 11, text fig. 5.—J. Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1889, p. 447 (list); Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 465.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, pl. 3, figs.

[4] Trans. Linn. Soc. London, Zoology, vol. 11, 1916, p. 207.

35, 36 (expl. of plates).—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 190.—Millett, Journ. Roy. Micr. Soc., 1898, p. 611, pl. 13, fig. 12.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 996.—Mestayer, Trans. New Zealand Instit., vol. 48, 1916, p. 128 (list).—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 412, pl. 85, figs. 1 *a*, *b*.

Test generally lenticular, periphery rounded, the early chambers arranged in a quinqueloculine manner, later ones in a single plane, the number in a coil increasing until in the adult as many as six may make up a complete coil; sutures indistinct; wall entirely calcareous, imperforate, smooth, dull; aperture at the peripheral margin, arched, with a flat, rounded tooth.

Diameter, 2 mm.; thickness, 0.75 mm.

This species was orginally described from the Miocene of the Vienna Basin and has been recorded from the Miocene of adjacent regions. As a living species it is known from several stations in the north Atlantic, especially off Ireland and the Faroe Channel, from the Mediterranean and the Indo-Pacific.

NUMMOLOCULINA IRREGULARIS (d'Orbigny)

Plate 10, Figures 2, 3

Biloculina irregularis d'Orbigny, Voy. Amér. Mérid. Foraminifères, 1839, p. 67, pl. 8, figs. 22–24.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 140, pl. 1, figs. 17, 18.

There are numerous records in the present oceans for this species but a glance at the figures given will show that many of them do not refer to the species as figured by d'Orbigny and by Brady. The *Challenger* specimens figured by Brady show three chambers in the adult in a single plane and may probably fit better into *Nummoloculina* than elsewhere. The apertural characters also are very similar.

There are a few Atlantic records for the species in fairly deep water.

Genus HAUERINA d'Orbigny, 1839

Hauerina d'Orbigny (Genoholotype, *Hauerina compressa* d'Orbigny), in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, " Foraminifères," pp. xxxviii, xxxix.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 190.—Chapman, The Foraminifera, 1902, p. 97.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 150.

Heterillina Munier-Chalmas and Schlumberger, Bull. Soc. Géol. France, ser. 4, vol. 5, 1905, p. 131.

Test with the early chambers quinqueloculine, later ones more or less in one plane, making a half coil, later in some species gradually shortening so that more than two make up one coil; aperture cribrate.

Tertiary and Recent.

This genus has developed from a quinqueloculine ancestry adding the later chambers in a single plane and then reducing the length so

that more than two chambers make a coil. With this change in structure is developed a strongly cribrate aperture.

HAUERINA BRADYI Cushman

Plate 10, Figures 4–9

Hauerina compressa H. B. Brady (not *H. compressa* d'Orbigny), Rep. Voy. *Challenger*, vol. 9, 1884, p. 190, pl. 11, figs. 12, 13.

Hauerina bradyi Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 62, pl. 23, fig. 2; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 72; Publ. 311, Carnegie Instit. Washington, 1922, p. 71; Publ. 344, 1926, p. 82.

Test much compressed, the very earliest ones milioline, later ones becoming spiroloculine, and finally, in the last-formed coil, more than two chambers appear, usually three making up a complete coil; wall very finely striate-reticulate; periphery rounded or subcarinate; aperture a sieve-plate the entire height of the chamber, curved, with numerous pores.

Diameter, 1 mm.; thickness, 0.15 mm.

This species is now know from the Tortugas, Jamaica, and Porto Rico, and so is probably widely distributed in the West Indian region. The largest specimens are from Porto Rico. In the Indo-Pacific the species is also widely distributed.

HAUERINA ORNATISSIMA (Karrer)

Plate 10, Figures 10–12

Quinqueloculina ornatissima Karrer, Sitz. Akad. Wiss. Wien, vol. 58, 1868, p. 151, pl. 3, fig. 2.

Hauerina ornatissima H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 192, pl. 7, figs. 15–22.—Millett, Journ. Roy. Micr. Soc., 1898, p. 610.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 178, p. 207 (list), p. 399 (list).—Fornasini, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 10, 1902, p. 27.—Dakin, Rep. Ceylon Pearl Oyster Fish., vol. 5, 1906, p. 231.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 53.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 590.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 63, pl. 23, figs. 1, 5; U. S. Geol. Survey, Bull. 676, 1918, p. 26, pl. 6, fig. 5; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 452; Publ. 311, Carnegie Instit. Washington, 1922, p. 72; Publ. 342, 1924, p. 67, pl. 24, figs. 7–9.—Heron-Allen and Earland, Journ. Linn. Soc. Zool., vol. 35, 1924, p. 609.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 37 (table).—Cushman, Publ. 344, Carnegie Instit. Washington, 1926, p. 82.

Test compressed, early chambers milioline, later ones either embracing and extending in to the center to cover the previously formed chambers or becoming elongate and more or less encircling the periphery; surface ornamented by strong transverse or radial ridges or crenulations crossed by numerous fine longitudinal striae; aperture consisting of numerous small pores in several linear series or scattered, the sieve plate thus formed extending the full height of the chamber.

Diameter up to 1.5 mm.

This species is typically an Indo-Pacific one, but occurs in the West Indian region and also apparently in the Mediterranean.

Genus SIGMOILINA Schlumberger, 1887

Sigmoilina Schlumberger (Genotype, by designation, *Planispirina sigmoidea* H. B. Brady), Bull. Soc. Zool. France, vol. 12, 1887, p. 118.

Spiroloculina (part) Costa (not d'Orbigny), Mem. Accad. Sci. Napoli, vol. 2, 1855 (1857), p. 126.

Planispirina (part) H. B. Brady (not Seguenza), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 197.

Test with the early chambers quinqueloculine, later ones added in planes slightly more than 180° from one another making a continuously revolving spiral and in transverse section producing a sigmoid appearance; aperture simple with a simple tooth; exterior very often with a superficial layer of arenaceous material.

Tertiary and Recent.

This genus very evidently developed from *Quinqueloculina* by the addition of chambers in planes more than 180° so that the resulting section is S-shaped.

SIGMOILINA CELATA (Costa)

Spiroloculina celata Costa, Mem. Accad. Sci. Napoli, vol. 2, 1855 (1857), p. 126, pl. 1, fig. 14; Atti Accad. Pontaniana, vol. 7, fasc. 2, 1856, pl. 26, fig. 5.

Planispirina celata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 197, pl. 8, figs. 1–4; Quart. Journ. Geol. Soc., vol. 44, 1888, p. 8 (table).—Terrigi, Mem. Com. Geol. Ital., vol. 4, pt. 1, 1891, p. 67, pl. 1, figs. 5, 6.—Egger (?), Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 245, pl. 3, figs. 37–39.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 190.—Woodward, The Observer, vol. 4, 1893, p. 77.—DeAmicis, Boll. Soc. Geol. Ital., vol. 12, fasc. 3, 1893, p. 36; Nat. Sicily, Ann. XIV, 1895, p. 55.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 303, pl. 47, fig. 5.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 35; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 216.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 10.—Koch, Ber. Schweiz. Pal. Ges., vol. 18, 1923, p. 344.

Sigmoilina celata J. Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1899, p. 447.—Chaster, First Rep. Southport Soc. Nat. Sci. 1890–91 (1892), p. 56.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 464.—Chapman, Proc. Zool. Soc. London, 1895, p. 11.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 81.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399 (list).—A. Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 22, 1904, pp. 267, 268.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 21, pl. 2, fig. 41; Subantarctic Islands of New Zealand, 1909, p. 323.—Schubert Abhandl. geol. k. k. Reichs., vol. 20, pt. 4, 1911, p. 126.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 61, pl. 24, fig. 1.—Heron-Allen and Earland, British Antarctic Exped., Zoology, vol. 6, 1922, p. 71; Journ. Roy. Micr. Soc., 1924, p. 133.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 37 (table).—Yabe and Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 49.

SIGMOILINA SCHLUMBERGERI Silvestri

Plate 11, Figures 1–3

Sigmoilina schlumbergeri Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 22, 1904, p. 267.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 21, pl. 2, fig. 42; Subantarctic Islands of New Zealand, 1909, p. 323; Journ. Linn. Soc. Zool., vol. 30, 1910, p. 398; Zool. Res. *Endeavour*, pt. 3, 1912, p. 310; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 11.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 449.

I have given above the principal references to these two species. The figure given by Costa is like so many of his, apparently poorly drawn as to details. According to Silvestri, Costa's type is not the same as the form figured by Brady which is the common one in the present oceans and which has a longer test with the sutures inconspicuous. This is another case where one must see the actual specimens of various authors to determine what they actually had although it is to be suspected that most of the records from recent seas are *S. schlumbergeri*. Several specimens are figured.

Sigmoilina schlumbergeri—Material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
				° ′ ″ ° ′ ″		° F.		
20726	U.S.N.M.	1	D2036	38 52 40 N.; 69 24 40 W.	1,735	38	glob. oz.	Rare.
20727	U.S.N.M.	1	D2038	38 30 30 N.; 69 08 25 W.	2,033	-------	glob. oz.	Rare.
20728	U.S.N.M.	2	D2039	38 19 26 N.; 68 20 20 W.	2,369	-------	glob. oz.	Rare.
20729	U.S.N.M.	2	D2097	37 56 20 N.; 70 57 30 W.	1,917	-------	glob. oz.	Rare.
20730	U.S.N.M.	2	D2015	37 50 00 N.; 73 03 50 W.	1,395	41	glob. oz.	Rare.
20731	U.S.N.M.	2	D2117	15 24 40 N.; 63 31 30 W.	683	39.75	yl. m. fne. s.	Rare.
20732	U.S.N.M.	10+	D2144	9 49 00 N.; 79 31 30 W.	896	-------	gn. m.	Common.
20733	U.S.N.M.	1	D2150	13 34 45 N.; 81 21 10 W.	382	45.75	wh. crs. s.	Rare.
20734	U.S.N.M.	2	D2226	37 00 00 N.; 71 54 00 W.	2,045	36.8	glob. oz.	Rare.
20735	U.S.N.M.	2	D2228	37 25 00 N.; 73 06 00 W.	1,582	36.8	br. m.	Rare.
20736	U.S.N.M.	2	D2381	28 05 00 N.; 87 56 15 W.	1,330	-------	lt. br. m.	Rare.
20737	U.S.N.M.	1	D2383	28 32 00 N.; 88 06 00 W.	1,181	39.8	br. gn. m.	Rare.
20738	U.S.N.M.	1	D2393	28 43 00 N.; 87 14 30 W.	525	41.1	lt. gy. m.	Rare.
20739	U.S.N.M.	1	D2399	28 44 00 N.; 86 18 00 W.	196	51.6	gy. m.	Rare.
20740	U.S.N.M.	5	D2400	28 41 00 N.; 86 07 00 W.	169	-------	gy. m.	Frequent.
20741	U.S.N.M.	1	D2562	39 15 30 N.; 71 25 00 W.	1,434	37.3	gy. oz.	Rare.
20742	U.S.N.M.	2	D2586	39 02 40 N.; 72 40 00 W.	328	40.2	dk. gy. m.	Rare.
9136	J.A.C.	10+	Flying Fox	Off S. W. Ireland	1,000	-------	-------	Common.
9137	J.A.C.	10+	Gold-seeker	Off S. W. Ireland	620	-------	-------	Common.

SIGMOILINA ASPERULA (Karrer)

Plate 11, Figures 4 *a*, *b*

Spiroloculina asperula Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abt. 1, 1868, p. 136, pl. 1, fig. 10.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 11, 13, 14.

Sigmoilina asperula Cushman, Bull. 103, U. S. Nat. Mus., 1918, p. 81, pl. 31, figs. 3 *a*, *b*.

Test but slightly longer than wide, lenticular, periphery rounded; chambers numerous, arranged in a sigmoid manner, several visible

from either side; sutures somewhat indistinct; wall calcareous, imperforate, covered on the exterior with fine arenaceous material; aperture slightly exserted, nearly circular.

Length, 0.8 mm.; breadth, 0.65 mm.; thickness, 0.20 mm.

There are a very few records for this species in the Atlantic. Brady records it from the Faroe Channel, and Brady, Parker, and Jones record it from the Abrohlos Bank off Brazil. There are numerous records for it in the fossil state and in the Indo-Pacific, but there is such a wide range in the character of the specimens figured that they should be restudied from the original specimens.

SIGMOILINA SIGMOIDEA (H. B. Brady)

Plate 11, Figures 5, 6

Planispirina sigmoidea H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 197, pl. 2. figs. 1–3, text fig. 5*c*.—Schlumberger, Bull. Soc. Zool. France, vol. 12, 1887, p. 106, pl. 7, figs. 9–11, text figs. 1–5.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 216, pl. 40, fig. 16.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 5.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 190.—Egger (?), Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 245, pl. 4, figs. 9, 10.—Woodward, The Observer, vol. 4, 1893, p. 77.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 302, pl. 47, fig. 6.—Heron-Allen and Earland, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 216, pl. 39, figs. 32–34.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 10.

Sigmoilina sigmoidea Schlumberger, Bull. Soc. Zool. France, vol. 12, 1887, p. 118.—Chapman, Proc. Zool. Soc. London, 1895, p. 11.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 80.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 20, pl. 2, fig. 40; p. 398; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 61, pl. 24, figs. 2, 3; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 448.—Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 71; Journ. Roy. Micr. Soc., 1924, p. 133.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 37 (table).—Yabe and Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 49.

Both this and the preceding species occur very widely distributed and in fairly deep water. *S. sigmoidea* has a very smooth porcellanous surface, usually glistening white with the sutures usually not visible except in the young. There are records for the species off the British Isles and off the northern border of the West Indies but in water of several hundred fathoms with numerous scattered stations elsewhere in the Atlantic always in water of considerable depth.

Genus ARTICULINA d'Orbigny, 1826

Articulina d'Orbigny (Genoholotype, *Articulina nitida* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 300.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 182.—Chapman, The Foraminifera, 1902, p. 93.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 150.

Nautilus Batsch (not Linnaeus), Conch. des Seesandes, 1791, p. 3.

Vertebralina (part) Parker, Jones, and H. B. Brady (not d'Orbigny), Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 22

Test with the early chambers quinqueloculine or triloculine, later ones in a rectilinear series; aperture in the adult a rounded, usually elliptical opening, at the end of a short neck with a phialine lip.

Lower Eocene to Recent.

This genus has developed from a quinqueloculine ancestry by the addition of a uniserial stage which is only represented by one or two chambers in some species but in others these become numerous.

ARTICULINA SAGRA d'Orbigny

Plate 11, Figure 7

Articulina sagra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 160, pl. 9, figs. 23–26.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73, pl. 18, figs. 2–5; Publ. 311, Carnegie Instit. Washington, 1922, p. 70; Publ. 344, 1926, p. 82.

Test elongate, composed of two portions, the earlier triloculine, the later uniserial, the triloculine portion generally elliptical, with a rounded periphery and longitudinal costae, the uniserial portion consisting of from one to three chambers, each broader than the preceding, transverse section circular or broadly elliptical; the aperture the broadest portion of the test, with an everted lip; the wall of the chamber longitudinally costate.

Length, 1 mm.; breadth, 0.20 mm.; thickness, 0.15 mm.

The species was originally described by d'Orbigny from Cuba, Jamaica, and Martinique. It is widely distributed in the shallow water, coral-reef regions of the West Indies. I have recorded it from Jamaica, Porto Rico, and the Tortugas.

ARTICULINA MEXICANA Cushman

Plate 12, Figures 2, 3

Vertebralina species Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64.
Articulina mexicana Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 70, pl. 11, figs. 7, 8.

Test somewhat compressed, generally rounded, the last-formed coil composed of two to three chambers; sutures somewhat indistinct, the single, uniserial chamber in the adult somewhat more compressed toward the apertural end, which has a somewhat everted lip, but extending only slightly beyond the general outline of the chamber; surface smooth, shining.

Length, 1.10 mm.; breadth, 0.95 mm.; thickness, 0.35 mm.

This smooth species is probably widely distributed in the West Indian region. I have recorded it only from Jamaica and the Tortugas region, but it is to be looked for elsewhere.

The test is thick and usually smooth and polished, but occasionally as in one of the figured specimens there are traces of costae. Uniserial chambers are unusual, but the typical lip is strongly developed.

ARTICULINA LINEATA H. B. Brady

Plate 11, Figures 8–10; Plate 12, Figure 1

Articulina lineata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 183, pl. 12, figs. 19–21.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73, pl. 18, fig. 6; Publ. 311, Carnegie Instit. Washington, 1922, p. 70, pl. 12, fig. 4.

Test much compressed, even in the earlier portion, which is triloculine, the later portion consisting of one or two much-compressed chambers in linear arrangement; the aperture with a lip much thickened at the edge, but not everted and not extending out beyond the periphery of the chamber; chambers distinct, with numerous fine longitudinal costae; wall translucent, of a bluish-white color.

Length, 1 mm.; breadth, 0.50 mm.; thickness, 0.15 mm.

This species occurs both in the Indo-Pacific and the West Indian region. It is known from Jamaica and the Tortugas region and as far north as Bermuda. There is usually but a single uniserial chamber but occasionally two are developed.

The shape of the test in the uniserial portion is very different from that in *A. sagra* where the lip is everted and the sides stand out beyond the chamber below. In *A. lineata* the lip though well developed does not stand out and the sides are curved downward so that the next added chamber is constricted at the base instead of broadened as in *A. sagra*. The costae of *A. lineata* are also much finer.

ARTICULINA MAYORI Cushman

Plate 12, Figure 5

Articulina mayori Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 71, pl. 13, fig. 5.

Test elongate, slender, early portion milioline, later chambers elongate, fusiform; surface faintly striate; apertural end contracted, with a distinct, everted lip; aperture circular.

Length, 1.60 mm.; breadth, 0.18 mm.

This species is known only from the Tortugas region off Florida. It is a slender species and easily broken which may account in part for its seeming rarity. The early stages are definitely quinqueloculine.

ARTICULINA ANTILLARUM Cushman

Plate 12, Figure 4

Articulina antillarum Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 71, pl. 12, fig. 5; Publ. 342, 1924, p. 66, pl. 25, fig. 1.

Test elongate, early portion in the microspheric form milioline, in the megalospheric form *Cornuspira*-like, the remainder and larger portion of the test made up of a linear series of elongate chambers gradually increasing in size toward the apertural end; chambers truncate at the distal end, then somewhat circular, without a lip; surface of the chambers with several rounded, longitudinal costae.

Length, up to 2 mm.; breadth, 0.30 mm.

The only Atlantic records for this species are from the Tortugas region off Florida, although it has since been found at Samoa. The following notes were made at the time the species was described.

Specimens of *A. antillarum* were found at a few stations, usually not in any considerable numbers. They resemble somewhat specimens referred to *Articulina conico-articulata* by Millett[5] but have a very different shape and appearance. They are very close to some of the specimens referred to this species by Heron-Allen and Earland from the Kerimba Archipelago.[6] Our specimens, however, have a much longer test, and their general appearance is somewhat different. There seems to be a difference in the form and shape of the chambers in the two forms, the megalospheric being less fusiform than in the microspheric.

It may be that more than one species is involved in the material placed under this name as the early stages are very different. The species should have a wide Indo-Pacific range.

ARTICULINA SULCATA Reuss

Plate 12, Figure 6

Articulina sulcata Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 383, pl. 49, figs. 13–17; Neues Jahrb., 1853, p. 673.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 1, 1884, p. 183, pl. 12, figs. 12, 13.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 215, pl. 40, fig. 11.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 5.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 243, pl. 3, fig. 5.—Woodward, The Observer, vol. 4, 1893, p. 77.—Millett, Journ. Roy. Micr. Soc., 1898, p. 510.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 16, pl. 4, figs. 16, 17.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 318.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1038.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 585.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 60, pl. 22, fig. 5.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123.

The above references are the most important ones referring to this species. It may be questioned whether all these can be referred to Reuss's species but forms which are similar in their characters are widely distributed in the Atlantic, Mediterranean, and especially the Indo-Pacific.

ARTICULINA MULTILOCULARIS H. B. Brady, Parker, and Jones

Plate 12, Figure 7

Articulina multilocularis H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 215, pl. 40, fig. 10.

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[5] Journ. Roy. Micr. Soc., 1898, pl. 12, figs. 9, 10.

[6] Trans. Zool. Soc. London, vol. 20, 1915, pl. 45, figs. 29, 31.

"Test (earlier portion?) free, oval, compressed or complanate; composed of numerous segments arranged as in *Spiroloculina;* lateral faces of the segments flat or slightly hollowed, peripheral edge square or obtuse-angular; apertural end broad, margin everted, orifice simple.

Length about one fiftieth of 1 inch (0.5 mm.)."

This species is only known from its original locality, Abrohlos Bank off Brazil.

Genus TUBINELLA Rhumbler, 1906

Tubinella Rhumbler (Genotype, by designation, *Articulina inornata* H. B. Brady), Zool. Jahrb., Abteil. Syst., vol. 24, 1906, p. 25.—Cushman, Special publ. No 1, Cushman Lab. Foram. Res., 1928, p. 151.

Articulina (part) H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 185.

Test with an ovoid early portion, the remainder of the test nearly straight, cylindrical; partially divided; aperture, the open end of the last chamber; color, bluish-white.

Recent.

This genus apparently has developed from a quinqueloculine young possibly through *Articulina* by acceleration of development. The wall seems to be imperforate and to have the peculiar bluish-white color so characteristic of the Miliolidae.

TUBINELLA FUNALIS (H. B. Brady)

Plate 12, Figure 8

Articulina funalis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 185, pl. 13, figs. 6–11.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 242, pl. 3, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1898, p. 513.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399 (list); vol. 30, 1907, p. 22, pl. 2, fig. 44.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 6.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 996.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 587.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 9.—Heron-Allen and Earland, British Antarctic Exped., Zoology, vol. 6, 1922, p. 72.

Tubinella funalis Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 26 pl. 2, fig. 3.—Cushman, Publ. 342, Carnegie Instit. Washington, 1924, p. 54, pl. 19, figs. 7, 8.

Test elongate, cylindrical, slightly tapering, the initial chamber elongate, bulbous, rounded at the base, remainder of chambers indistinct; wall with very fine longitudinal striae; aperture formed by the open end of the last-formed chamber.

Length up to 2.4 mm.

This is a very widely distributed species being known in the Atlantic from a *Challenger* station off Prince Edward's Island. Except for this record, all the others are from the Mediterranean or the Indo-Pacific.

TUBINELLA FUNALIS (H. B. Brady), var. INORNATA (H. B. Brady)

Plate 12, Figure 9

Articulina funalis H. B. Brady, var. *inornata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 186, pl. 13, figs. 3–5.—Millett, Journ. Roy. Micr. Soc., 1898, p. 513, pl. 12, fig. 11.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399 (list).—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 6; Journ. Roy. Micr. Soc., 1918, p. 10.—Heron-Allen and Earland British Antarctic Exped., Zoology, vol. 6, 1922, p. 72.

Tubinella inornata Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 27 pl. 2, fig. 4.

Variety differing from the typical in having the surface entirely smooth.

This occurs with the typical form at many stations. The only record from the Atlantic is that from the *Challenger* station off Prince Edward's Island given by Brady.

Genus NUBECULINA Cushman, 1924

Nubeculina Cushman (Genoholotype, *Nubecularia divaricata* H. B. Brady), Publ. 342, Carnegie Instit., Washington, 1924, p. 52; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 151.

Sagrina (part) H. B. Brady (not d'Orbigny), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 276.

Nubecularia (part) H. B. Brady (not Defrance) Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 133.

Test elongate, uniserial; initial end coiled or milioline; chambers distinct, simple; wall imperforate, porcellanous, with sand grains attached to the exterior; aperture at the end of an elongated tubular neck with an everted phialine lip, the apertural opening with a series of inwardly pointing teeth.

Recent.

This genus is only known from the Indo-Pacific.

Genus TRILOCULINA d'Orbigny, 1826

Triloculina d'Orbigny (Genotype, by designation, *Miliola trigonula* Lamarck), Ann. Sci. Nat., vol. 7, 1826, p. 299.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 151.

Miliola (part) Lamarck Ann. Mus., vol. 5, 1804, p. 351.

Miliolina (part) Williamson, Rec. Foram. Great Britain, 1858, p. 83 (and later authors).

Test with the early chambers quinqueloculine, at least in the microspheric form, later ones added in the planes 120° from one another, the third of each series added in the plane of the third preceding and covering it so that the surface of the test is composed of but three visible chambers, interior not labyrinthic; aperture simple, typically with a bifid tooth.

Triassic to Recent.

This genus is definitely derived from *Quinqueloculina* by the addition of chambers 120° apart and three making up a complete cycle and the aperture typically with a bifid tooth. In the microspheric form all the stages are usually present but in the megalospheric form the early quinqueloculine stages may be entirely skipped and the triloculine stage taken on at once.

SPECIES WITH SMOOTH EXTERIOR

TRILOCULINA TRIGONULA (Lamarck)

Plate 12, Figures 10, 11; Plate 13, Figures 1, 2

Miliola trigonula LAMARCK, Ann. Mus., vol. 5, 1804, p. 351, No. 3, vol. 9, 1807, pl. 17, fig. 4.

Triloculina trigonula D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1858, p. 299, No. 1, pl. 16, figs. 5–9; Modèles 1826, No. 93.

Miliolina trigonula WILLIAMSON, Rec. Foram. Gt. Britain, 1858, p. 84, pl. 7, figs. 180–182.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 164, pl. 3, figs. 14–16.

Test in the adult with three visible chambers, the angles rounded, the periphery broadly convex, whole test somewhat longer than wide, in end view rounded triangular, the sides convex; sutures distinct; wall smooth; aperture with a rather broad bifid tooth.

Length, 1 mm: breadth, 0.65–0.85 mm.

There are very many records for this species, but it is very doubtful if even a large proportion of them should be placed here. Lamarck's type is from the Eocene of the Paris Basin and is a well-defined species different from much of the recent material of similar form. A study of sections should be made before the full characters of the many similar forms can be known in detail.

TRILOCULINA TRICARINATA d'Orbigny

Plate 13, Figures 3 *a–c*

Triloculina tricarinata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 7; Modèles, 1826, No. 94.—H. B. BRADY, Trans. Linn. Soc. London, vol. 24, 1864, p. 446, pl. 48, fig. 3.

Miliolina tricarinata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 165, pl. 3, figs. 17 *a*, *b*.

Test in the adult with three visible chambers, the angles of the chambers sharply angled often almost carinate, whole test usually somewhat longer than wide, in end view triangular, the sides straight; sutures distinct; wall smooth, often polished; aperture with a narrow bifid tooth or variously angled in large specimens.

Length up to 2 millimeters.

This is another species that needs monographic study with abundant material, both fossil and recent and many sections. There are evidently several species included under this name, but only careful study of sectioned specimens especially of the microspheric form will

bring out the differences. The references are very numerous and the apparent distribution of the species very wide. Little is to be gained at the present state of our knowledge by giving either references or distribution.

TRILOCULINA OBLONGA (Montagu)

Plate 13, Figures 4, 5

Vermiculum oblongum MONTAGU, Test. Brit., 1803, p. 522, pl. 14, fig. 9.

Triloculina oblonga D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 16; Modèles, No. 95; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839 "Foraminifères," p. 175, pl. 10, figs. 3–5.—H. B. BRADY, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 472 (table); Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 93; Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 46.—TERQUEM, Essai Class. Anim. Dunkerque, 1875, p. 38, pl. 5, figs. 19 *a*, *b*.—J. WRIGHT, Proc. Belfast Nat. Field Club, Appendix, 1876–77, p. 103.—KIAER, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 26.—CUSHMAN, Contrib. Canad. Biol., 1921 (1922), p. 15; Publ. 311, Carnegie Instit. Washington, 1922, p. 73.

Miliolina oblonga TERRIGI, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880, p. 51, pl. 1, fig. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 160, pl. 5, figs. 4 *a*, *b*.—BALKWILL and MILLETT, Journ. Micr., vol. 3, 1884, p. 6.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 324.—SIDDALL, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 62 (list).—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc., vol. 12, 1888, p. 214, pl. 40, fig. 27.—J. WRIGHT, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1889, p. 447.—HALKYARD, Trans. Manchester Micr. Soc., 1889, p. 60.—CHASTER, First Rep't Southport Soc. Nat. Sci., 1890–91 (1892), p. 55.—WOODWARD, The Observer, vol. 4, 1893, p. 76.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 110, pl. 20, figs. 850–850*f*.—FLINT, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 297, pl. 43, fig. 3.—J. WRIGHT, Irish Nat., vol. 9, 1900, p. 52.—EARLAND, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 194.—MILLETT, Rec. Foram. Galway, 1908, p. 4.—CUSHMAN, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 26.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1909, p. 312; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 25; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 210.

Miliolina seminulum (Linnaeus), var. *oblonga* WILLIAMSON, Rec. Foram. Gt. Britain, 1858, p. 86, pl. 7, figs. 186, 187.

Test elongate, the adult with three visible chambers, the last-formed chamber broadest near the initial end and longer than the preceding ones; test in end view triangular, the sides broadly curved and angles rounded, chambers inflated; sutures distinct, depressed; wall smooth and usually polished; aperture oval with the tooth simple or narrow and bifid at the tip.

Length, 1 mm.; breadth, 0.55 mm.; thickness, 0.35 mm.

This species is very widely distributed or else more than one species is recorded under this name. The principal references to Atlantic material are given but not those of other regions nor fossil ones except in the case of Terrigi who first used the combination with *Miliolina*. As a recent species at least off the European coasts it seems very definite in its characters.

TRILOCULINA CIRCULARIS Bornemann

Plate 13, Figures 6, 7; Plate 14, Figures 1, 2

Triloculina circularis Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349.—Reuss, Sitz. Akad. Wiss. Wien, vol. 48, pt. 1, 1863, p. 41.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 67, pl. 25, fig. 4; pl. 26, fig. 1; Publ. 213, Carnegie Instit. Washington, 1918, p. 290; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 638; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 462, pl. 92, figs. 1, 2; Publ. 311, Carnegie Instit. Washington, 1922, p. 73.—Hofker, Flora en Fauna der Zuiderzee, Protozoa, 1922, p. 135, text fig. 15.—Cushman, Publ. 342, Carnegie Instit. Washington, 1924, p. 69, pl. 25, figs. 5, 6; Publ. 344, 1926, p. 82.

Miliolina circularis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 169, pl. 4, figs. 3 *a–c*; pl. 5, figs. 13, 14.—Sherborn and Chapman, Journ. Roy. Micr. Soc., ser. 2, vol. 6, 1886, p. 742, pl. 14, figs. 2 *a*, *b*.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 13, 1890, p. 162.—Terrigi, Atti Accad. Lincei, ser. 4, Mem., vol. 6, 1893, p.108, pl. 4, fig. 10.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 188.—Woodward, The Observer, vol. 4, 1893, p. 76.—Egger, Abhandl. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 235, pl. 2, figs. 61–63.—Chapman, Proc. Zool. Soc. London, 1895, p. 9.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 82.—Millett, Journ. Roy. Micr. Soc., 1898, p. 499, pl. 11, figs. 1, 3 (not fig. 2).—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 173.—Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1900, p. 52.—Sidebottom, Mem. Proc. Manchester Lit. Philos Soc., vol. 48, No. 5, 1904, p. 8.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 196.—Chapman, Trans. New Zealand Instit., vol. 38, 1905 (1906), p. 81.—Dakin, Rep't Ceylon Pearl Oyster Fish., vol. 6, 1906, p. 229.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 121; Journ. Linn. Soc. Zool., vol. 30, 1907, p. 17, pl. 2, fig. 27.—Millett, Rec. Foram. Galway, 1908, p. 5.—Cushman, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 26, pl. 5, figs. 5, 6, 10.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 313.—Chapman, Subantarctic Islands New Zealand, 1909, p. 318; Journ. Linn. Soc. Zool., vol. 30, 1910, p. 397.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 3.—Schubert, Abhandl. geol. K. K. Reichs., vol. 20, pt. 4, 1911, p. 124.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 26.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 995.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 8; Victorian Nat., vol. 32, 1915, p. 49, fig. 2 in text.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 557; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 209.—Chapman, Rep't British Antarctic Exped., Geol., vol. 2, 1916 (1917), p. 42, pl. 5, fig. 3.—Halkyard, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918 (1919), p. 10.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 8.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 116; British Antarctic Exped., Zool., vol. 6, 1922, p. 64; Journ. Roy. Micr. Soc., 1924, p. 131.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 8, pl. 1, figs. 19–21.—Heron-Allen and Earland, Journ. Linn. Soc. Zool., vol. 35, 1924, p. 604; Trans. Zool. Soc. London, vol. 22, pt. 1, 1926, p. 69 (list).—Chapman, New Zealand Geol. Surv., Pal. Bull., No. 11, 1926, p. 25, pl. 7, fig. 7.

Test rounded, compressed, the periphery rounded, the three chambers making up the visible portion of the test, rounded, inflated, last-formed chamber strongly embracing; sutures distinct, depressed;

wall smooth, polished; aperture, a narrow crescentiform slit with a large, flattened, semicircular tooth.

Length, 1 mm.; breadth, 1 mm.; thickness, 0.35 mm.

This is a common species in shallow water both in tropical and subtropical or temperate regions. In the Tropics it is very constant in its characters but some of the colder water forms assigned to it do not fit as well the specific characters. The tooth in side view is seen to be somewhat in front of the aperture. Quinqueloculine early stages are often found and there is a tendency for the chambers to assume a single plane of growth.

Variety *sublineata* H. B. Brady may not really belong to this species but needs further study.

TRILOCULINA CIRCULARIS Bornemann, var. SUBLINEATA H. B. Brady

Heron-Allen and Earland record this variety as new to the British Isles from the Clare Island region of Ireland[7] in the following words:

"Specimens found at four stations present the characteristic features of this somewhat doubtful variety as figured by Brady; that is, the fine costae, which in the commoner species M[*iliolina*] *seminuda* Reuss, are confined to the peripheral margin of the chambers, are here apparent over the whole surface of the shell."

The other records for this variety are from the Indo-Pacific.

TRILOCULINA GRACILIS d'Orbigny

Plate 14, Figures 4 *a–c*

Triloculina gracilis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 159, pl. 11, figs. 10–12.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 74.

Test elongate, slender, triloculine; chambers rounded; sutures very slightly depressed; apertural end extended into a cylindrical neck, the outer end of which is enlarged and has a phialine lip; surface smooth or very finely striate; aperture circular, with a slight tooth.

Length, 0.50 mm.; breadth, 0.35 mm.; thickness, 0.10 mm.

This species was described by d'Orbigny from shore sands of Cuba and Jamaica as rare. It has occurred in material from the Tortugas region. The originals of d'Orbigny suggest a slight surface ornamentation but those that I have seen are smooth. This is a very small slender species and easily overlooked.

TRILOCULINA ROTUNDA d'Orbigny

Plate 14, Figures 3 *a–c*

Triloculina rotunda d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 4.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 206, pl. 1, figs. 48–50.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 73; Publ. 344, 1926, p. 82.

[7] Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 26.

Miliolina rotunda MILLETT, Journ. Roy. Micr. Soc., 1898, p. 267, pl. 5, figs. 15, 16.—SIDEBOTTOM, Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 8.

Test somewhat longer than wide; chambers rotund; periphery broadly rounded; surface of the test made up largely or entirely of the two last-formed chambers; sutures very slightly depressed; apertural end somewhat contracted, with a slightly thickened lip; aperture rounded, with a single bifid tooth, projecting somewhat above the outline of the aperture; surface of the test smooth and shining, often with transverse wrinkles.

Length, 0.80 mm.; breadth, 0.60 mm.; thickness, 0.50 mm.

There are in the collections from the Tortugas specimens which may be referred to this species. This is one of the smooth, somewhat generalized forms to which many things have been referred. The figures are of a Tortugas specimen.

TRILOCULINA BUCCULENTA (H. B. Brady)

Plate 15, Figures 1 *a–c*

Miliolina bucculenta H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 170, pl. 114, figs. 3 *a*, *b*.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 118, pl. 23, figs. 890–903; pl. 24, figs. 904, 905.—FLINT, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 299, pl. 45, fig. 1.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 995.—HERON-ALLEN and EARLAND, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 208, pl. 39, figs. 4–6.

"Test subglobular, more or less compressed, the two sides nearly symmetrical, margin lobulated; segments inflated, broad and embracing, the last three forming a single convolution, which completely encloses the preceding ones. Aperture a long, irregularly arched, transverse slit, on the face of the terminal segment, near the line of union with the previous convolution. Diameter one-twelfth of 1 inch (2 mm.)."

The above description is the original of Brady. The species is apparently characteristic of cold waters of the North Atlantic and Arctic although it has been recorded elsewhere but not usually in its typical form. The figures are after Heron-Allen and Earland from specimens off the west coast of Scotland.

Brady describes variety *placentiformis* from off the West Indies in 390 fathoms. This seems to be a very irregular form and needs further study.

TRILOCULINA LABIOSA d'Orbigny

Plate 15, Figures 2, 3

Triloculina labiosa D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 157, pl. 10, figs. 12–14.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 70; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 16, figs. 13, 14; Publ. 311, Carnegie Instit. Washington, 1922, p. 77, pl. 12, fig. 1; Publ. 344, 1926, p. 83.

Miliolina labiosa H. B. Brady. Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 170, pl. 6, figs. 3–5.

Test much broader than long; surface largely composed of the two last-formed chambers; chambers often somewhat irregular; periphery rounded; surface smooth, but dull; aperture crescentiform, with a somewhat triangular tooth, placed somewhat back from the aperture.

Diameter, 0.60 mm.; thickness, 0.20 mm.

D'Orbigny described this species from Cuba, and similar specimens occur in the general West Indian region as well as elsewhere. A typical specimen from the Tortugas is figured and another specimen from off the coast of Ireland which may be this species.

TRILOCULINA ANCONENSIS Schultze

Plate 15, Figure 4

Miliolina anconensis Schultze, Organ. Polythal., 1854, p. 58, pl. 2, figs. 12, 13.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 568; Trans. Linn. Soc. Zool., ser. 2, vol. 11, 1916, p. 211.

Heron-Allen and Earland refer specimens from the west coast of Scotland to this species described by Schultze from off Ancona. The figure is after the type figure of Schultze.

TRILOCULINA VALVULARIS Reuss

Heron-Allen and Earland [8] record this species from the Clare Island region of Ireland as follows:

A few undoubted examples of this form, in which the aperture is narrowed to a slit by the presence of an enlarged plate, instead of the usual tooth were observed at station 36. Specimens of *M[iliolina] subrotunda* exhibiting a tendency toward *M. valvularis* were observed at six or seven other stations. It has previously been recorded from British waters only by Mr. Pearcey from the Faröe Channel.

Reuss originally described the species from the Oligocene near Berlin.

TRILOCULINA PELLUCIDA (Egger)

Miliolina pellucida Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 229, pl. 2, figs. 7–12.

Among other localities for this species Egger includes a station from 677 meters off the west coast of Africa. I examined the type of this species in Munich. It is a very thin fragile form.

SPECIES WITH COSTATE EXTERIOR

TRILOCULINA LINNEIANA d'Orbigny

Plate 16, Figures 1, 2

Triloculina linneiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 172, pl. 9, figs. 11–13.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 72, pl. 27, fig. 4; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 3, 4; Publ. 311, Carnegie Instit. Washington, 1922, p. 75.

[8] Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 27.

Test typically with three visible chambers in the adult, elongate, tapering toward either end, somewhat depressed; surface ornamented by a few very prominent, raised ridges, with deep concave depressions between; periphery rounded or slightly elliptical, with a simple or bifid tooth.

Length, 1.6 mm.; breadth 0.90 mm.; thickness 0.70 mm.

This is a fine, large, well-characterized species especially well developed in the West Indian region. D'Orbigny's originals came from shore sands of Cuba and Jamaica. It is apparently widely distributed in the Indo-Pacific and there are many references for it although they are not given here until a study of sections shall show that the two are really the same species.

The tooth in side view projects beyond the outline of the test and often has a large perforation as seen in one of the figures given.

TRILOCULINA PLANCIANA d'Orbigny

Plate 15, Figures 5, 6

Triloculina planciana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 173, pl. 9, figs. 17–19.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 7, 8; Publ. 311, Carnegie Instit. Washington, 1922, p. 74; Publ. 344, 1926, p. 83.

Test elongate; chambers distinct; sutures slightly, if at all, depressed; periphery broadly rounded; wall ornamented by numerous short, incised lines; aperture rounded, with a bifid tooth, projecting slightly above the apertural opening; surface polished.

Length, 0.65 mm.; breadth, 0.35 mm.; thickness, 0.30 mm.

This species was originally described by d'Orbigny from Cuba and Jamaica. It has been found in my material from Montego Bay and Runaway Bay on the north coast of Jamaica, from Porto Rico, and from numerous stations in the Tortugas region.

The surface is peculiarly marked with short incised lines but these are a constant character.

TRILOCULINA TRANSVERSESTRIATA (H. B. Brady)

Plate 16, Figure 3

Miliolina transversestriata H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 45; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 177, pl. 4, figs. 6 *a–c*.—Millett, Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, fig. 5.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 566, pl. 42, figs. 17–20.

Triloculina transversestriata Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70; Publ. 311, Carnegie Instit. Washington, 1922, p. 74; Publ. 344, 1926, p. 82.

Test elongate, two to three times as long as broad; periphery subacute; surface ornamented by numerous obliquely transverse costae; apertural end slightly extended; aperture rounded, with a simple tooth.

Length, 0.70 mm.; breath, 0.35 mm.; thickness, 0.20 mm.

Most of the records for this species are from the Indo-Pacific where it is known from the Kerimba Archipelago off the east coast of Africa to Torres Strait and the Malay Archipelago.

In the West Indies I have had it from Montego Bay on the north coast of Jamaica, from Porto Rico, and from the Tortugas region. Heron-Allen and Earland record it from Havana, Cuba. The specimens from Porto Rico while they have the shape of the others do not always show the surface ornamentation as well.

TRILOCULINA BRONGNIARTII d'Orbigny

Plate 16, Figure 4

Triloculina brongniartii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 23.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 250, pl. 8, fig. 9.

Miliolina brongniartii Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 2.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 33; Trans. Zool. Soc., vol. 20, 1915, p. 580; Trans. Linn. Soc. London, vol. 11, ser. 2, 1916, p. 214; British Antarctic Exped., Zool., vol. 6, 1922, p. 70.

The original figure given by Soldani is here copied. Except for this figure copied from the original by Parker, Jones, and H. B. Brady, the species has been recorded several times without being figured. The specimen shows a test that is longitudinally costate, the periphery slightly sinuous and the apertural end produced with a much-contracted neck and small rounded aperture.

I have not seen the species in the western Atlantic, though it is recorded from about the British Isles and the Pacific region.

Heron-Allen and Earland (1913, p. 33) make the following statement:

> In *M [ilionina] Brongniartii* the shell is typically oval or nearly circular in outline; the aperture is broad and practically flush with the periphery; and the sutural depressions between the chambers are very slightly marked. The outline of the test as seen in section would be lenticular. The striae are fine, and follow the outline of the chambers in curved parallels.

This would give a form somewhat different from that figured by Soldani.

TRILOCULINA FICHTELIANA d'Orbigny

Plate 17, Figures 1 *a–c*

Triloculina fichteliana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 171, pl. 9, figs. 8–10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 71; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 1, 2; Publ. 311, Carnegie Instit. Washington, 1922, p. 75; Publ. 344, 1926, p. 83.

Test subcircular in front view, somewhat compressed; periphery rounded; chambers distinct; sutures slightly depressed; wall ornamented by numerous longitudinal costae; aperture semicircular, with a slight tooth.

Diameter, 0.60 mm.; thickness, 0.45 mm.

D'Orbigny described this species from shore sands of Cuba and Jamaica. I have had specimens from the north coast of Jamaica, from Porto Rico, and from the Tortugas region.

The figures referred to this species given by Brady in the *Challenger* report do not correspond well with those given by d'Orbigny. The West Indian material fits much more closely. As many later records for this species are undoubtedly based upon the figures in the *Challenger* report, it is difficult to know the real distribution of the species outside of the West Indian region.

TRILOCULINA QUADRILATERALIS d'Orbigny

Triloculina quadrilateralis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 173, pl. 9, figs. 14–16.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 71, text fig. 11; Publ. 311, Carnegie Instit. Washington, 1922, p. 76.

Test somewhat longer than broad, in the adult the exterior composed of three chambers, generally quadrangular in outline, the periphery slightly convex, but the angles acute and projecting, sides concave; wall with numerous fine, incised short lines; aperture oblong, with a single elongate tooth, projecting slightly above the outline of the aperture.

Length, 0.65 mm.; breadth, 0.35 mm.; thickness, 0.30 mm.

This species was described by d'Orbigny from shore sands of Cuba. It is a widely distributed and common species in the West Indian region. I have had it from the north coast of Jamaica and from numerous stations off the coast of Florida. The young does not develop the full characters but the adult has the very square chambers with the angles sharp or carinate. The apertural neck is distinctly developed in the adult and there is a well-developed lip.

TRILOCULINA INSIGNIS (H. B. Brady)

Plate 17, Figures 2 *a*, *b*

Miliolina insignis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 165, pl. 4, figs. 8, 10.—J. Wright, Proc. Belfast Nat. Field Club, Appendix, 1885-86, p. 319, pl. 26, figs. 4 *a*, *b*.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 3.—Woodward, The Observer, vol. 4, 1893, p. 76.—Chapman, Proc. Zool. Soc. London, 1895, p. 9.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 86.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 299, pl. 45, fig. 2.—J. Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1900, p. 52.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 196.—Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 81.—Dakin, Rep't. Ceylon Pearl Oyster Fish., vol. 6, 1906, p. 228.—Chapman, Subantarctic Islands of New Zealand, 1909, p. 318.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 303.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 8.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 562; British Antarctic Exped., Zool., vol. 6, 1922, p. 65.

Triloculina insignis Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 72, pl. 27, figs. 3 *a*, *b*; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 458.

Test in the adult with three visible chambers, the angles usually rounded, test somewhat longer than broad; sutures distinct, depressed; wall ornamented by numerous fine longitudinal costae; aperture nearly circular with a narrow bifid tooth.

Length about 1 mm.

This species has been recorded from north of the West Indies and in the region of the British Isles as well as in the other oceans.

TRILOCULINA SUBORBICULARIS d'Orbigny

Plate 16, Figure 5; Plate 17, Figure 3

Triloculina suborbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 12; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 177, pl. 10, figs. 9–11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 70, pl. 21, fig. 3; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 461.

Miliolina suborbicularis Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 9; vol. 54, No. 16, 1910, p. 3.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 304; Trans. Zool. Soc, London, vol. 20, 1915, p. 560; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 210, pl. 39, figs. 7–9; Bull. Soc. Sci. Hist. Nat. Corse, 1922. p. 117.

Test suborbicular, much compressed laterally, often broader than long, peripheral margin rounded; sutures distinct, depressed; wall longitudinally costate, the earliest chambers sometimes nearly smooth; aperture subcircular with a flattened lip, tooth simple, semicircular, at some distance in front of the aperture on the periphery of the preceding coil.

Diameter, 0.85 mm.; thickness, 0.30 mm.

Nearly all the records for this species are from the Mediterranean and Indo-Pacific. Heron-Allen and Earland record it from off the west coast of Scotland, and I have specimens from the north coast of Jamaica that are apparently this species.

SPECIES WITH RETICULATE SURFACE

TRILOCULINA CARINATA d'Orbigny

Plate 17, Figure 4

Triloculina carinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 179, pl. 10, figs. 15–17.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 71, pl. 17, figs. 9, 10; Publ. 311, Carnegie Instit. Washington, 1922, p. 75, pl. 12, fig. 6.

Test longer than broad; surface in the adult made up of three chambers, typically with the periphery carinate, with the surface ornamented with small rounded pits in regular series, covering the entire surface, except about the aperture; sutures distinct, somewhat depressed; aperture elongate, narrow, with a distinct, slightly everted lip, tooth very long and narrow, projecting somewhat above the apertural opening.

Length, 1.50 mm.; breadth, 0.65 mm.; thickness, 0.35 mm.

This species was described by d'Orbigny from shore sands of Cuba as rare. It is, however, a common and widely distributed species of the West Indian region. The surface reticulations are very regular in size and position. The periphery in this species is carinate while in the following one it is truncate with double keels. In some specimens of *T. carinata*, the periphery in the adult becomes rounded.

TRILOCULINA BICARINATA d'Orbigny

Plate 17, Figure 5

Triloculina bicarinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 158, pl. 10, figs. 18–20.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 76, pl. 12, fig. 7; Publ. 344, 1926, p. 83.

Test longer than broad, triloculine, typically with the chambers with a truncate periphery, the angles somewhat extended; chambers distinct; sutures somewhat depressed; surface ornamented by reticulations both on the sides and on the outer angles; aperture elongate, with a definite thin lip, slightly everted, tooth elongate, narrow, extending above the outline of the aperture.

Length, 1.4 mm.; breadth, 0.80 mm.; thickness, 0.50 mm.

This species was described by d'Orbigny from shore sands of Cuba. I did not find it in Jamaica but it has occurred at Porto Rico and at the Tortugas. It is close to the preceeding species but differs as already noted in the shape of the chambers and also in the surface markings. Those of *T. bicarinata* are more or less rectangular while those of *T. carinata* are usually rounded or elliptical.

TRILOCULINA MACULATA (Egger)

Miliolina maculata Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 238, pl. 2, figs. 85, 86.

Egger describes this species from the West Coast of Africa in 677 fathoms. The original figure is rather poor and the species is mentioned here for the Atlantic record.

Genus TRILLINA Munier-Chalmas and Schlumberger, 1893

Trillina Munier-Chalmas and Schlumberger (Genoholotype, *Trillina howchini* Schlumberger), Bull. Soc. Geol. France, ser. 3, vol. 21, 1893, p. 118.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 154.

Test similar in plan of development to *Triloculina*, but with the chambers labyrinthic and the aperture cribrate.

Eocene.

Genus FLINTINA Cushman, 1921

Flintina Cushman (Genoholotype, *Flintina bradyana* Cushman), Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 465; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 154.

Miliolina (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pp. 169, 184.

Test in the early stages, at least of the microspheric form, quinqueloculine, followed very early by a triloculine stage and in the adult planispiral, usually taking three chambers to make a complete cycle; aperture with a large orifice with a thickened border and large complex tooth.

Recent.

This genus is well developed in the Indo-Pacific, especially in the Phillippine region where there are some large species.

Genus PTYCHOMILIOLA Eimer and Fickert, 1899

Ptychomiliola Eimer and Fickert (Genoholotype, *Miliolina separans* H. B. Brady), Zeitschr. Wiss. Zool., vol. 65, 1899, p. 687.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 154.

Miliolina (part) H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 45.

Test in the early stages triloculine, completely involute, in the later stages with the chambers uncoiling, and in fully developed specimens with the last chambers tending to become uniserial; aperture with a distinct tooth, typically bifid.

Recent. Shallow waters of the tropical Indo-Pacific.

This genus develops from such forms as *Flintina* by adding the loosely coiled development followed by a uniserial stage in the final development. The next stage would be a completely uncoiled development in the megalospheric stage at least, and such forms are to be looked for.

PTYCHOMILIOLA SEPARANS (H. B. Brady)

Plate 17, Figures 6–8

Miliolina separans, H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 175, pl. 7, figs. 1–4.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 239, pl. 2, figs. 53, 54.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 300, pl. 46, fig. 6.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 121.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1038.

Ptychomiliola separans Eimer and Fickert, Zeitschr. Wiss. Zool., vol. 65, 1899, p. 687, text figs.

This species with its peculiar uncoiling is known only from shoal water of the Indo-Pacific, except for the one record of Pearcey from the Abrohlos Bank off Brazil.

Genus PYRGO DeFrance, 1824

Pyrgo DeFrance (Genoholotype, *Pyrgo laevis* DeFrance), Dict. Sci. Nat., vol. 32, 1824, p. 273.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 155.

Miliola (part) Lamarck, Ann. Mus., vol. 5, 1804, p. 351.

Biloculina d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 297 (genotype, by designation, *B. bulloides* d'Orbigny).

Test with the early chambers at least in the microspheric form quinqueloculine, followed by a triloculine series, and in the adult added in planes 180° apart and involute, the interior simple, the

exterior of the test composed of but two chambers; aperture typically with a broad bifid tooth.

Lias to Recent.

In its microspheric form this genus shows all three stages—quinqueloculine, triloculine, and biloculine—but in the specimens with a small megalospheric proloculum acceleration takes place and the quinqueloculine stage is skipped, and in specimens with a very large proloculum the biloculine character is taken on at once and both the quinqueloculine and triloculine stages are skipped entirely.

A number of the species of this genus have become adapted to a cold, deep-water habitat, an unusual one for most of the genera of this family.

PYRGO SUBSPHAERICA (d'Orbigny)

Plate 18, Figures 1, 2

Biloculina subsphaerica D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 162, pl. 8, figs. 25–27.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73; Publ. 311, Carnegie Instit. Washington, 1922, p. 77; Publ. 344, 1926, p. 83.

Test small, rotund, slightly longer than broad, somewhat broader than thick, chambers rounded, periphery rounded; suture distinct, depressed, in side view showing a sinuous line concave toward the last-formed chamber near the aperture and concave toward the preceding chamber at the opposite end; wall smooth and polished; aperture broadly oval with a somewhat flattened tooth with short lateral extensions at the tip only partially filling the aperture.

Length, 0.50 mm.; breadth, 0.40 mm.; thickness, 0.35 mm.

This is a characteristic West Indian species originally described from this region by d'Orbigny. It has proved to be the most common species of the genus in this region. I have had it from Jamaica, Cuba, Porto Rico, the Tortugas region, and from numerous stations along the Florida coast and in the Bahamas. It never attains a large size.

PYRGO MILLETTII (Cushman)?

Plate 19, Figure 1

Miliolina durrandii MILLETT (part), Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, figs. 8–10 (not fig. 7).

Biloculina millettii CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 81, pl. 34, figs. 4, 5; Publ. 311, Carnegie Instit. Washington, 1922, p. 77; Publ. 342, 1924, p. 71.

Test in front view, broadly elliptical; in end view, compressed; chambers biconvex; the periphery with a definitely developed carina; wall smooth, except for occasional transverse ribs usually indistinct; aperture slightly produced, broadly elliptical, with a slightly thickened border joining the carina at its outer edge; the aperture with a small bifid tooth.

The record for this species in the West Indian region rests on a single specimen from the Tortugas material. The specimen is here

figured. It shows a decided resemblance to this species which is known from the Indo-Pacific.

PYRGO DENTICULATA (H. B. Brady)

Plate 18, Figures 3, 4

Biloculina ringens Lamarck, var. *denticulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 4, 5.—Woodward, The Observer, vol. 4, 1893, p. 76.—Millett, Journ. Roy. Micr. Soc., 1898, p. 262.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 398 (list).—Dakin, Rep't. Pearl Oyster Fish. Ceylon, 1906, p. 220.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 551, pl. 40, figs. 11–13.

Biloculina denticulata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 80, pl. 33, fig. 1; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 476, pl. 98, figs. 3 *a–b;* Publ. 311, Carnegie Instit. Washington, 1922, p. 78; Publ. 342, 1924, p. 70; Publ. 344, 1926, p. 83.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 38 (table).

Test elongate, roughly quadrangular in front view; in end view somewhat compressed, biconvex; apertural end broadly rounded; opposite end with a series of short, irregular teeth; wall smooth, usually polished; aperture very broad and narrow, extending nearly the whole width of the test, the ends somewhat expanded, with a long, narrow tooth, making the inner border of the aperture plate-like, somewhat raised above the level of the surface to which it is attached, as is the whole border of the aperture.

Length, 1.10 mm.; breadth, 0.80 mm.; thickness, 0.60 mm.

This is typically an Indo-Pacific species and is widely distributed in shallow water, coral-reef conditions. In the Atlantic it is known from the West Indies in shallow water at various localities and is recorded from the Cape Verde Islands.

The denticulate border is not always present but the general shape of the test is constant.

PYRGO DENTICULATA (H. B. Brady), var. STRIOLATA (H. B. Brady)

Plate 18, Figures 5 *a–c*

Biloculina ringens (Lamarck), var. *striolata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 7, 8.—Chapman, Proc. Zool. Soc. London, 1895, p. 8.—Millett, Journ. Roy. Micr. Soc., 1898, p. 262, pl. 5, fig. 8.—Dakin, Rep't. Pearl Oyster Fish. Ceylon, 1906, p. 228.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 551; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 602.

Biloculina denticulata (H. B. Brady), var. *striolata* (H. B. Brady), Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 80, pl. 33, figs. 2, 3; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 477, pl 98, figs. 2 *a–c;* Publ. 311, Carnegie Instit. Washington, 1922, p. 78; Publ. 342, 1924, p. 70.

Variety differing from the typical in the addition of a surface ornamentation consisting of a series of costae on the lower half of the penultimate chamber, occasionally on the ultimate also.

This variety is usually found with the typical form of the species. The figured specimen represents an extreme form, not typical, in

which the test is much more timid and less wide than in the ordinary form.

It is not so widely distributed nor so common in the Atlantic as is the typical form.

PYRGO ELONGATA (d'Orbigny)

Plate 19, Figures 2, 3.

Biloculina elongata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298, No. 4; Prod. Pal., vol. 2, 1850, p. 409, No. 1350.—H. B. Brady, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 472 (table); Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 92; Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 46.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 247, pl. 8, fig. 6.—Terquem, Mém. Soc. Geol. France, ser. 3, vol. 2, 1882, p. 154, pl. 16 (24), figs. 1 *a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 144, pl. 2, figs. 9 *a*, *b*.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 62 (list).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 214, pl. 40, figs. 21, 22.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 1.—Chaster, First Rep't. Southport Soc. Nat. Sci., 1890–91 (1892), p. 55.—Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 184, pls. 11, 12, figs. 87–89, text figs. 35, 36.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 184.—De Amicis, Boll. Soc. Geol. Ital., vol. 12, fasc. 3, 1893, p. 18.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol.18, 1893, p. 220, pl. 1, figs. 1–3.—Woodward, The Observer, vol. 4, 1893, p. 76.—Goës, Kongl. Svensk-Vet. Akad. Handl., vol. 25, No. 9, 1894, p.119, pl. 24, fig. 912 (not 906–911, 913).—A. Silvestri, Atti Accad. Sci. Acireale, vol. 7, 1896, p. 10.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 112, pl. 1, figs. 15 *a*, *b*.—Millett, Journ. Roy. Micr. Soc., 1898, p. 263.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 294, pl. 39, fig. 4.—Kiaer, Rep't. Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 25.—Fornasini, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 10, 1902, p. 20.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 3.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 15, pl. 1, fig. 14.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 118.—Cushman, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 25, pl. 5, figs. 7–9—Chapman, Subantarctic Islands of New Zealand, 1909, p. 317.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 2.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 301; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 22, pl. 1, fig. 4.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 993.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 552.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 6.—Heron-Allen and Earland, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 205.—Chapman, Rep't. British Antarctic Exped., Geol., vol. 2, 1916 (1917), pp. 28, 57, pl. 2, fig. 6.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 78, pl. 31, fig. 1.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 114; British Antarctic Exped., Zool., vol. 6, 1922, p. 62; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 603.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 38 (table).—Chapman, New Zealand Geol. Surv., Pal. Bull. 11, 1926, p. 24.—Cushman, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1,.1927, p. 141.

Test elongate, somewhat pyriform, tapering gradually toward the apertural end, rounded at the opposite end, in end view subelliptical,

the periphery rounded; suture distinct, depressed wall smooth; aperture generally broadly elliptical with a small flattened tooth partially filling the opening.

Length, 0.75 mm.; breadth, 0.50 mm.; thickness, 0.40 mm.

The species is widely distributed but appears to be more at home in temperate regions than in the Tropics. It has not been found in the West Indian region but is known from the eastern coast of the United States and from the coasts of Europe with many records from the Mediterranean and Indo-Pacific.

PYRGO DEPRESSA (d'Orbigny)

Plate 19, Figures 4, 5

Biloculina depressa d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298, No. 7, Modèles No. 91.

There has been much confusion in regard to this and related species. From a study of d'Orbigny's model, it is apparent that *P. depressa* has a very much compressed test, with a keel entirely about the periphery and with the aperture very narrow and elongate with a flattened, very broad tooth nearly filling the aperture. Such specimens are widely distributed, but, as Brady figures in the *Challenger* report, as this species, specimens with a tubular neck and rounded aperture with a small bifid tooth, many of the later records based on these figures are doubtful without seeing the actual specimens. The typical form of the species is here figured from off the southwest coast of Ireland. It is widely distributed but usually in cool and fairly deep waters.

The form figured by Williamson as *Biloculina ringens*, var. *carinata*[9] is probably this species. His figures are reproduced here (pl. 19, fig. 5).

Pyrgo depressa—Material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
				° ′ ″ ° ′ ″				
20768	U.S.N.M.	3	D2228	37 25 00 N.; 73 06 00 W.	1,582	36.8	br. n.	Rare.
20769	U.S.N.M.	3	D2377	29 07 30 N.; 88 08 00 W.	210	67.0	gy. m.	Rare.
20770	U.S.N.M.	1	D2385	28 51 00 N.; 88 18 00 W.	730	40.1	gy. m.	Rare.
9138	J.A.C.	10+	Lord Bandon.	Off S. W. Ireland				Common.
9139	J.A.C.	5	Lord Bandon.	Off S. W. Ireland	37.5			Few.

PYRGO MURRHINA (Schwager)

Plate 19, Figures 6, 7

Biloculina murrhina Schwager, *Novara*-Exped., Geol., vol. 2, 1866, p. 203, pl. 4, figs. 15 *a-c*.—Munier-Chalmas and Schlumberger, Bull. Soc. Géol. France, ser. 3, vol. 13, 1885, p. 283, figs. 9, 10; p. 290, figs. 15, 16.—

[9] Rec. Foram. Gt. Britain, 1858, pl. 7, figs. 172-174.

Schlumberger, Mém. Soc. Géol. France, vol. 4, 1891, p. 165, pl. 9, figs. 52, 54, figs. 8, 9 in text.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, pl. 1, figs. 19, 20.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 87.—Schubert, Abhandl. geol. k. k. Reichs., vol. 20, 1911, p. 122, text fig. 17.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 994.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 19, text fig. 25; p. 75, pl. 28, fig. 3; pl. 29, fig. 1; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 470; Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 140.

Biloculina depressa d'Orbigny, var. *murrhyna* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 146, pl. 2, figs. 10, 11.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 462.—Chapman, Proc. Zool. Soc. London, 1895, p. 7.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 117.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 395; Zool. Res. *Endeavour*, pt. 3, 1912. p. 310; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 3.—Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 62.

Test in front view, in young specimens, nearly circular, in adult specimens somewhat longer than broad, in end view ellipsoid, with the borders extended and carinate, the carina interrupted at the point opposite the aperture, leaving a sinus, rather deep and often with a long spine at each angle in young specimens; in adults, sinus less deep, and the spines usually reduced or wanting; wall smooth; aperture in the young with a neck not exceeding the periphery of the test; in adults with a prominently exserted tubular neck with a bifid tooth partially filling the nearly circular opening; wall smooth.

Diameter up to 1.5 mm.; thickness, 0.50 mm.

This is a deep-water species and is very widely distributed in all the ocean basins. There are comparatively few previous records from the Atlantic.

Pyrgo murrhina—material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
				° ′ ″ ° ′ ″				
20748	U.S.N.M.	1	D2377	29 07 30 N.; 88 08 00 W.	210	67	gy. m	Rare.
20749	U.S.N.M.	1	D2382	28 19 45 N.; 88 01 30 W.	1,255	39.6	gy. m	Rare.
20750	U.S.N.M.	1	D2542	40 00 15 N.; 70 42 20 W.	129	47.2	s. brk. sh	Rare.
20751	U.S.N.M.	5	D2562	39 15 30 N.; 71 25 00 W.	1,434	37.3	gy. oz	Few.
20752	U.S.N.M.	1	D2097	37 56 20 N.; 70 57 30 W.	1,917		glob. oz	Rare.
20753	U.S.N.M.	5	D2106	37 41 20 N.; 73 03 20 W.	1,497	42.5	glob. oz	Few.
20754	U.S.N.M.	1	D2144	9 49 00 N.; 79 31 30 W.	896		gn. m	Rare.
20755	U.S.N.M.	6	D2117	15 24 40 N.; 63 31 30 W.	683	39.75	yl. m. fne. s	Frequent.
20756	U.S.N.M.	3	D2042	39 33 00 N.; 68 26 45 W.	1,555	38.5	glob. oz	Few.
20757	U.S.N.M.	2	D2041	39 22 50 N.; 68 25 00 W.	1,608	38	glob. oz	Rare.
20758	U.S.N.M.	4	D2018	37 12 22 N.; 74 20 04 W.	788	39	bu. m	Few.
20759	U.S.N.M.	2	D2036	38 52 40 N.; 69 24 40 W.	1,735	38	glob. oz	Rare.
20760	U.S.N.M.	3	D2038	38 30 30 N.; 69 08 25 W.	2,033		glob. oz	Rare.
20761	U.S.N.M.	10+	D2039	38 19 26 N.; 68 20 20 W.	2,369		glob. oz	Common.
20762	U.S.N.M.	1	D2160	23 10 31 N.; 82 20 37 W.	167		co	Rare.
20763	U.S.N.M.	3	D2204	39 30 30 N.; 71 44 30 W.	728	39.1	br. m	Rare.
20764	U.S.N.M.	1	D2225	36 05 30 N.; 69 51 45 W.	2,512	36.7	yl. oz	Rare.
20765	U.S.N.M.	7	D2226	37 00 00 N.; 71 54 00 W.	2,045	36.8	glob. oz	Frequent.
20766	U.S.N.M.	10	D2234	39 09 00 N.; 72 03 15 W.	810	38.6	gn. m	Frequent.
20767	U.S.N.M.	7	D2385	28 51 00 N.; 88 18 00 W.	730	40.1	gy. m	Frequent.

PYRGO SERRATA (L. W. Bailey)

Biloculina serrata L. W. Bailey, Boston Journ. Nat. Hist., vol. 7, 1862, p. 350, pl. 8, fig. E.—Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 163, pl. 9, figs. 50, 51, figs. 6, 7 in text.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, pl. 25, fig. 926; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 87.—Chapman, Subantartic Islands of New Zealand, 1909, p. 314.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 994.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 75, pl. 29, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 471, pl. 95, figs. 3 *a*, *b*.—Yabe and Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 49.—Cushman, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 140, pl. 2, fig. 3.

Biloculina depressa d'Orbigny, var. *serrata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 146, pl. 3, figs. 3 *a–c*.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 185, pl. 4, fig. 5.—Chapman, Proc. Zool. Soc. London, 1895, p. 7.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 294, pl. 40, fig. 2.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 396.—Schubert, Abhandl. Geol. k. k. Reichs., vol. 20, 1911, p. 122.—Heron-Allen and Earland, British Antarctic Exped., Zoology, vol. 6, 1922, p. 63; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 602.

Test in front view nearly circular, central portion tumid, compressed toward periphery forming a carina which is deeply serrate, the middle of the margin opposite the aperture with a deep sinus, serrations less deep toward the apertural end; wall smooth, often polished; aperture subcircular with a narrow neck, usually not exserted, tooth strongly bifid.

Diameter up to 2 millimeters.

This is another deep water species well distributed in all the great ocean basins.

Brady described this as a variety under the name *serrata* in 1884 but the name had been used in 1862 for the same form by L. W. Bailey in the reference given above.

Pyrgo serrata—Material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
				° ′ ″ ° ′ ″				
20771	U.S.N.M.	3	D2018	37 12 22 N.; 74 20 04 W.	788	39	bu. m	Rare.
20772	U.S.N.M.	1	D2050	39 42 50 N.; 69 21 20 W.	1,050	44.5	glob. oz	Rare.
20773	U.S.N.M.	7	D2377	29 07 30 N.; 88 08 00 W.	210	67	gy. m	Frequent.
20774	U.S.N.M.	1	D2399	28 44 00 N.; 86 18 00 W.	196	51.6	gy. m	Rare.

PRYGO COMATA (H. B. Brady)

Plate 19, Figure 8

Biloculina comata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 144, pl. 3, figs. 9 *a*, *b*.—Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 178, pl. 10, figs. 72, 73, text figs. 26–28.—Woodward, The Observer, vol. 4, 1893, p. 75.—Goës, Kongl. Svensk. Vet. Akad. Handl.,

vol. 25, No. 9, 1894, p. 117, pl. 22, figs. 883, 884.—Chapman, Proc. Zool. Soc. London, 1895, p. 8.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 86.—Flint, Ann. Rep't U. S. Nat. Mus., 1897 (1899), p. 294, pl. 39, fig. 3.—Kiaer, Rep't. Norwegian Fish. Mar. Invest., vol. 1, No. 7, 1900, p. 26.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 117.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 81, pl. 34, fig. 1.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 4.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 640; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 477, pl. 96, figs. 3 *a*, *b*.—Heron-Allen and Earland, British Antarctic Exped., Zool. vol. 6, 1922, p. 62.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 38 (table).

Test subglobular, the chambers very much inflated, in end view subcircular; suture distinct, incised; wall ornamented with numerous, fine, longitudinal costae; aperture elongate, with a tooth often with winglike extensions at the ends.

Length, up to 2.5 mm.; thickness, 1.85 mm.

There are a number of records for this species in the Atlantic, mostly in deep water. It is a beautifully ornamented species and not likely to be confused with any other.

PYRGO INFLATA (J. Wright)

Biloculina ringens Balkwill and Wright, var., Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 322, pl. 12, figs. 6, 7.

Biloculina inflata J. Wright, Proc. Liverpool Geol. Soc., vol. 9, 1902, p. 183, pl. 13, figs. 1-4.—Heron-Allen and Earland, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 206.

This peculiar form has been recorded off the British Isles in the above references. Nothing more is known of its distribution, and I have had no specimens for study.

There are many records from the Atlantic and elsewhere which have been referred to *Biloculina ringens* (Lamarck) and *B. bulloides* d'Orbigny. So many of these are evidently erroneous, especially since the researches of Schlumberger have shown what are the essentials of these two species in section, that they all need reexamining.

As long ago as 1891, Schlumberger in his "Revision des Biloculines des Grands Fonds" [10] gave many excellent sections as well as exterior figures of numerous species from the Gulf of Gascony and elsewhere. These, for the most part, have not been followed up by later authors, most of them being content to refer their species to a few of the older names where they evidently do not belong. A study of either Recent or fossil species of Pyrgo should be studied with adequate sections and distinctions carefully drawn as indicated in the above paper of Schlumberger.

Schlumberger's species *Pyrgo sarsi*, *P. labiata*, *P. bradyi*, *P. vespertilio*, *P. fischeri*, *P. milne-edwardsi*, *P. pisum* and *P. anomala* have been found elsewhere and their ranges should be checked.

[10] Mém. Soc. Zool. France, vol. 4, 1891, pp. 155–191, pls. 9–12, text figs. 1–46.

Genus FABULARIA Defrance, 1820

Fabularia Defrance (Genoholotype, *Fabularia discolithes* Defrance), Dict. Sci. Nat., vol. 16, 1820, p. 103.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 155.

Test similar to *Pyrgo* but the chambers labyrinthic and the aperture cribrate.

Eocene to Miocene.

Dillina proposed by Munier-Chalmas and Schlumberger probably belongs here.

This represents a specialized Tertiary development from *Pyrgo*, but the genus became extinct and is not found in the present oceans.

Genus FLINTIA Schubert, 1911

Flintia Schubert (Genoholotype, *Spiroloculina robusta* H. B. Brady), Abhandl. k. k. Geol. Reichs., vol. 20, pt. 4, 1911, p. 124.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 155.

Spiroloculina (part) of Authors (not d'Orbigny).

Test in the early stages completely involute like *Biloculina*, only two chambers making up the exterior, later the chambers not completely involute, not covering the early chambers at the sides of the test and in the adult spiroloculine; wall calcareous, imperforate; aperture with a broad, flat tooth with curved ends.

Tertiary and Recent.

This genus while it resembles *Spiroloculina* in the adult has evidently been derived from *Biloculina* by the development of open coils as an adult character.

FLINTIA ROBUSTA (H. B. Brady)

Plate 20, Figures 1, 2

Spiroloculina robusta H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 150, pl. 9, figs. 7, 8.—Woodward, The Observer, vol. 4, 1893, p. 76.—Chapman, Proc. Zool. Soc. London, 1895, p. 8.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 80.—Flint, Ann. Rep't U. S. Nat. Mus., 1897 (1899), p. 296, pl. 42, figs. 1, 2.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 170; vol. 30, 1910, p. 396.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 33; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 404, pl. 79, figs. 2 *a*, *b*.

Flintia robusta Schubert, Abhandl. k. k. Geol. Reichs., vol. 20, pt. 4, 1911, p. 124.

Test in the earlier stages, in the microspheric form at least, biloculine and involute, later with newly added chambers less involute and a spiroloculine development added, the whole test becoming compressed; wall smooth except for the ridges formed by the chamber edges; aperture generally circular.

Diameter up to 1.65 mm.; thickness, 0.80 mm.

This species is well developed in fairly deep water in the Atlantic north of the Antilles but is recorded elsewhere in deep water. Its development is from a biloculine young and its resemblance to *Spiroloculina* only a case of parallelism.

Genus NEVILLINA Sidebottom, 1905

Nevillina Sidebottom, (Genoholotype, *Nevillina coronata* Sidebottom), Mem. Proc. Manchester Lit. and Philos. Soc., vol. 49, pt. 2, No. 11, 1905, p. 1.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 156.

Test similar to *Pyrgo* in the young, but in the adult the last-formed chamber almost completely embracing the earlier ones; aperture circular, complex, formed by numerous incurved lamellae meeting centrally; chambers not labyrinthic.

Recent.

This genus is very restricted in its distribution, being found in the Sulu Sea in a few fathoms.

Genus IDALINA Schlumberger and Munier-Chalmas, 1884.

Idalina Schlumberger and Munier-Chalmas, (Genoholotype, *Biloculina antiqua* d'Orbigny), Bull. Soc. Géol. France, ser. 3, vol. 12, 1884, p. 629.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 158.

Biloculina (part) d'Orbigny, Prod. Pal., vol. 2, 1850, p. 210.

Test in the microspheric form quinqueloculine, followed by a triloculine, then biloculine series and in the adult with the penultimate chamber showing as a narrow strip at one side near the base and the final chamber making up the remainder of the surface of the test; aperture cribrate but the chambers not labyrinthic.

Upper Cretaceous.

Genus PERILOCULINA Munier-Chalmas and Schlumberger, 1885

Periloculina Munier-Chalmas and Schlumberger (Genoholotype, *Periloculina zitteli* Munier-Chalmas and Schlumberger), Bull. Soc. Géol. France, ser. 3, vol. 13, 1885, p. 308.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 158.

Test similar to *Idalina*, but the last-formed chamber completely involute, the chambers labyrinthic; aperture complex, cribrate.

Upper Cretaceous.

Genus LACAZINA Munier-Chalmas, 1882

Lacazina Munier-Chalmas (Genoholotype, *Alveolina compressa* d'Orbigny), Bull. Soc. Géol. France, ser. 3, vol. 10, 1882, p. 472.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 158.

Test in the young similar to *Periloculina*, but in the adult compressed into a flattened spheroid, the apertures appearing as a ring of pores near the periphery on the dorsal side.

Upper Cretaceous.

Family 17. OPHTHALMIDIIDAE

Test calcareous, imperforate, early chambers at least planispiral, except in degenerate forms; wall without an arenaceous coating; aperture typically open, without a tooth.

This family is somewhat closely related to the Miliolidae and yet the two have few points in common. The early history of the Ophthalmidiidae is now much better known than formerly due to the greater knowledge of the Carboniferous and Permian foraminifera. The ancestry of the group can be traced back to *Glomospira*-like beginnings and the development of the calcareous, imperforate test from such arenaceous forms. *Cornuspira* itself while very primitive is probably derived through such forms as *Hemigordius*. In *Hemigordius*, the early stages, at least in the microspheric form, are coiled in varying planes finally becoming planispiral in the adult. *Hemigordius* is only known from the Carboniferous. By acceleration of development, these early stages become progressively reduced and the planispiral *Cornuspira* results. The very early forms of *Cornuspira* are often seen with the earliest coils irregular, but in later geologic periods the planispiral character becomes fixed in both the microspheric and megalospheric forms.

In *Vidalina*, in the Cretaceous, large forms are developed which are completely involute but such forms were specialized and did not persist beyond the Cretaceous. In *Cornuspiroides* the height of the coil greatly increases and a fan-shaped test results. These are known only from the present ocean. In *Cornuspirella* the later stages are very greatly spreading into long, branching, peripheral expansions, representing also a specialized type of the present ocean.

The next stage in development is for the undivided chamber to be divided into definite chambers. These may be in a more or less rectilinear series as in *Nodobacularia*, or be attached and spreading in different directions as in *Cornuspiramia*. *Nodobacularia* developed at least in the early Jurassic and still persists.

In the next group of genera the coiled chambers become divided into chambers growing progressively shorter as the test is developed. Such simple forms as *Ophthalmidium* are known from the early Jurassic as is also *Spiropthalmidium*, and both persist to the present ocean. *Planispirina* developed at least as early as the Cretaceous. *Renulina* became specialized in the Eocene, the chambers elongating, finally becoming annular and the genus not persisting beyond the Eocene. The most complex form of all, *Discospirinia*, is one of the best of the foraminifera to show developmental stages. As it is but a single chamber in thickness and the wall very thin, the whole test may be viewed by transmitted light. The early chambers follow the usual

development in the family with a proloculum, long coiled *Cornuspira*-like chamber, with progressively shorter chambers, the chambers spreading and finally becoming annular but with the division into chamberlets incomplete. The resemblance to the *Orbitolites* group is purely due to parallelism as the development of the two groups is entirely different. *Discospirinia* is a rare form known from fairly deep water and apparently also from late Tertiary deposits. In *Vertebralina*, there is a tendency to adopt a rectilinear development in the later stages. This is known since the Eocene.

There are also attached forms included in this family which have become degenerate, losing much of their structure. In *Nubecularia*, which developed early in the Jurassic the chambers are distinct, in a single plane, and the test attached. Such forms persist in modified shape to the present ocean. In *Calcituba* and *Silvestria*, the chambers become very irregular and in *Squamulina* a single-chambered test is developed of very simple degenerate form.

The Ophthalmidiidae have a calcareous imperforate test in common with the Miliolidae and both are derived from a *Glomospira*-like ancestry. The Miliolidae have developed the coiling in constantly changing planes and upon it built many structural modifications whereas the Ophthalmidiidae adopted almost at once a planispiral form of test which is variously modified. The development of apertural teeth and the incorporation of sand grains in the exterior of the test in the simpler form of the Miliolidae are characters not seen in the Ophthalmidiidae.

Subfamily 1. CORNUSPIRINAE

Test made up of a proloculum and an elongate, planispiral, tubular second chamber.

Genus CORNUSPIRA Schultze, 1854

Cornuspira SCHULTZE (Genotype, by designation, *Cornuspira planorbis* Schultze), Organismus Polythal., 1854, p. 40.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 198.—CHAPMAN, The Foraminifera, 1902, p. 99.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 160.

Orbis (part) PHILIPPI, Enum. Moll. Siciliae, vol. 2, 1844, p. 147.

Operculina (part) CZJZEK, in Haidinger's Nat. Abhandl., vol. 2, 1848, p. 146.

Spirillina (part) WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 91.

Test consisting of a proloculum followed by a long planispirally coiled second chamber, rounded or complanate; wall calcareous, imperforate; aperture formed by the open end of the chamber, sometimes constricted and with a thickened lip.

Carboniferous (?) Jurassic to Recent.

CORNUSPIRA FOLIACEA (Philippi)

Plate 20, Figures 3–5

Orbis foliaceus Philippi, Enum. Moll. Sicil., vol. 2, 1844, p. 147, pl. 24, fig. 26.

Cornuspira foliacea Carpenter, Parker, and Jones, Introd. Foram., 1862, p. 68, pl. 5, fig. 16.—H. B. Brady, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 472 (table).—Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 121, pl. 1, figs. 8, 9.—Parker and Jones, Phil. Trans., vol. 155, 1865, p. 408, pl. 15, fig. 33.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon. 19, 1866, p. 2, pl. 3, figs. 50, 51.—H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 92.—Reuss, Sitz. Akad. Wiss. Wien, vol. 55, abt. 1, 1867, p. 67.—Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abt. 1, 1868, p. 131.—Reuss, Sitz. Akad. Wiss. Wien, vol. 62, abt. 1, 1870, p. 464.—v. Schlicht, Foram. Sept. Pietzpuhl, 1870, pl. 35, figs. 11, 12.—H.B.Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 45.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 238, pl. 8, figs. 1, 2.—Schwager, Boll. Com. Geol. Ital., vol. 8, 1877, p. 27, pl. 104.—Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 76.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 120, pl. 9, figs. 308–310.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 199, pl. 11, figs. 5–9.—Balkwill and J. Wright, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 326, pl. 12, figs. 1 *a*, *b*.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 4.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 465.—A. Silvestri, Mem. Acad. Pont. Nuovi Lincei, vol. 9, 1893, p. 191.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 247, pl. 3, figs. 20, 21.—Woodward, The Observer, vol. 4, 1893, p. 77.—Hosius, Nat. Ver. Osnabrück. Jahrb., 1893–94 (1895), p. 77.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 106, pl. 17, fig. 834.—A. Silvestri, Atti Accad. Sci. Acireale, vol. 7, 1895–96, p. 41.—Jones, Pal. Soc. Mon. 19, pt. 2, 1895, p. 128, pl. 3, figs. 50, 51, text figs. 10 *a*, *b*.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 79.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 114, pl. 1, fig. 16.—Flint Ann. Rep't U. S. Nat. Mus., 1897 (1899), p. 303, pl. 48, fig. 1.—Millett Journ. Roy. Micr. Soc., 1898, p. 612.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 22.—Rhumbler, Arch. Prot., vol. 3, 1903, p. 287, fig. 141, in text.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 24, pl. 3, fig. 48.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 123.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 318; 1910, p. 305, pl. 9, figs. 5, 6.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54. No. 16, 1910, p. 7.—Cushman, Rep't Canad. Arctic Exped., 1913, p. 11.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 36.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 996.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 592; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 216.—Chapman, British Antarctic Exped., Geol., vol. 2, 1916 (1917), p. 60, pl. 1, fig. 9.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 6, 24, pl. 1, fig. 1; pl. 2, fig. 1, figs. 4, 5, in text.—Halkyard, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918 (1919), p. 18.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 387, pl. 77, fig. 1; Contrib. Canadian Biol., 1921 (1922), p. 14.—Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 73; Journ. Roy. Micr. Soc., 1924, p. 134.—Chapman, New Zealand Geol. Surv., Pal. Bull. 11, 1926, p. 27, pl. 7, fig. 11.—Hanna and Church, Journ. Pal., vol. 1, 1928, p. 197.

Cornuspira planorbis Schultze, Organ. Polythal., 1854, p. 40, pl. 2, fig. 21.

Test complanate, planispiral, early portion with the coils of nearly uniform diameter, but in later coils rapidly increasing in height, forming a broad, flattened test; spiral suture distinct; wall smooth except for the thickenings caused by the lines of growth; aperture, a long narrow slit the entire height of the chamber.

Length of largest specimens 10 millimeters or more.

This species develops to its maximum in the colder waters of the Arctic and North Temperate Zones. It is widely distributed in the various ocean basins but reaches smaller proportions elsewhere.

Cornuspira foliacea—*Material examined*

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
				° ′ ″ ° ′ ″ .				
20744	U.S.N.M.	2	D2172	38 01 15 N.; 73 44 00 W.	568	39	gn. m	Rare.
20745	U.S.N.M.	2	D2221	39 05 30 N.; 70 44 30 W.	1,525	36.9	gy. oz	Rare.
20746	U.S.N.M.	1	D2078	41 11 30 N.; 66 12 20 W.	499	40	gy. m. and s.	Rare.

CORNUSPIRA INVOLVENS (Reuss)

Plate 20, Figures 6, 8

Operculina involvens Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 370, pl. 46, fig. 30.

Cornuspira involvens Reuss, Sitz. Akad. Wiss. Wien, vol. 48, Abt. 1, 1863, p. 39, pl. 1, fig. 2; vol. 50, abt. 1, 1864, p. 450; Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 121.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon. 19, 1866, p. 3, pl. 3 figs. 52–54.—Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abt. 1, 1868, p. 131.—Hantken, Magy. kir. földt. int. evkönyve, vol. 4, 1875 (1876), p. 16, pl. 2, fig. 2.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 401; Denkschr. Akad. Wiss. Wein, vol. 43, 1881, p. 8; Proc. Roy. Soc. Edinburgh, 1882, p. 714; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 200, pl. 11, figs. 1–3.—Andreae, Abhandl. Geol. Special-Karte Elsass-Loth., vol. 2, pt. 3, 1884, p. 127.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 5, pl. 1, fig. 1.—Balkwill and J. Wright, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 327, pl. 12, figs. 2 *a*, *b*.—Burbach, Zeitschr. Nat., vol. 59, 1886, p. 497, pl. 5, fig. 1.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 63 (list).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 216, pl. 40, figs. 1–3.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1889, p. 484, pl. 11, figs. 4, 5.—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 62.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 4; vol. 13, 1890, p. 164.—Chaster, First Rep't. Southport Soc. Nat. Sci., 1890–91 (1892), p. 56.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 466.—Chapman, Journ. Roy. Micr. Soc., 1891, p. 575, pl. 9, figs. 12 *a*, *b*.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 246, pl 3, figs. 18, 19.—Woodward, The Observer, vol. 4, 1893, p. 77.—Hosius, Nat. Ver. Osnabrück, Jahrb. 1893–94 (1895), p. 77.—Jones, Pal. Soc. Mon. 19, pt. 2, 1895, p. 128, pl. 3, figs. 52–54, figs. 11 *a*, *b* in text.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 303, pl. 48, fig. 3.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 114.—Millett, Journ. Roy. Micr. Soc., 1898, p. 612.—J. Wright, Irish Nat., vol. 9, 1900, p. 53.—Chapman,

Journ. Linn. Soc. Zool., vol. 28, 1900, p. 179.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 22.—Rhumbler. Arch. Prot., vol. 3, 1903, p. 285, fig. 137 in text.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 199.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 30, pl. 2, fig. 6.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 22, pl. 2, fig. 46.—Millett, Rec. Foram. Galway, 1908, p. 5, pl. 1, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 123.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 318; 1910, p. 405.—Chapman, Subantarctic Islands of New Zealand, 1909, p. 325.—J. Wright, Proc. Belfast Nat. Field Club, Appendix, 1910–11, p. 7.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 7.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 36.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 996.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 12.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 593; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 217.—Chapman, British Antarctic Exped., Geol., vol. 2, 1916 (1917), pp. 29, 43, 60, pl. 2, fig. 8.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 5, 25, pl. 1, fig. 2; pl. 2, fig. 2, figs. 2, 3 in text.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 11.—Halkyard, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918 (1919), p. 18.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 634.—Klähn, Mitth. Nat. Ges., vol. 14, 1916–17 (1920), p. 41, pl. 10, figs. 3–5.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 389, pl. 77, figs. 3, 4.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 124; British Antarctic Exped., Zool., vol. 6, 1922, p. 74.—Hofker, Flora en Fauna der Zuiderzee, Protozoa, 1922, p. 133, fig. 11 in text.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 58; U. S. Geol. Surv. Prof. Paper 129-E, 1922, p. 101, pl. 25, fig. 1; 129-F, 1922, p. 140; Prof. Paper 133, 1923, p. 50.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1924, p. 134.—Cushman, Publ. 342, Carnegie Instit. Washington, 1924, p. 51, pl. 18, figs. 1, 2.—Heron-Allen and Earland, Journ. Linn. Soc. Zool., vol. 35, 1924, p. 610.—Cushman, Contrib. Cushman Lab. Foram. Res., vol. 1, pt. 2, 1925, p. 44.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 22, pt. 1, 1926, p. 69 (list).—Chapman, New Zealand Geol. Surv., Pal. Bull, 11, 1926, p. 27, pl. 3, figs. 1, 2.—Cushman, Publ. 344, Carnegie Instit. Washington, 1926, p. 80.—Hanna and Church, Journ. Pal., vol. 1, 1928, p. 197.

Test nearly circular in side view, consisting of a proloculum and a long closely coiled, planispiral second chamber of nearly equal diameter throughout, slightly involute; suture distinct, somewhat depressed; wall smooth and polished, occasionally showing slight lines of growth; aperture nearly the size of the open end of the tube.

Diameter usually not exceeding 1 millimeter.

As will be seen by the above references this is apparently a very common and widely distributed species. It is very simple in its characters and it is quite possible that detailed study of specimens from many regions will show more than one species. It occurs in very shallow warm waters of tropical coral-reef conditions in the West Indies but somewhat similar forms are found in deeper cooler waters. The young stages of other species may easily be taken for *C. involvens*.

Cornuspira involvens—material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
20747	U.S.N.M.	1	D2312	° ′ ″ 32 54 00 N.; ° ′ ″ 77 53 30 W.	88	57.8	crs.s bk.sp	Rare.

CORNUSPIRA SELSEYENSIS Heron-Allen and Earland

Plate 20, Figure 9

Cornuspira sp.? Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 199, pl. 13, figs. 2–4.

Cornuspira selseyensis Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 319, pl. 15, figs. 9–11; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 37; Trans. Zool. Soc. London, vol. 20, 1915, p. 592; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 217; Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 125; British Antarctic Exped., Zool., vol. 6, 1922, p. 74; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 610.

"Test free; bilaterally complanate, consisting of a conical tube coiled upon itself in one plane, the width of the tube approximately doubling at each convolution. Primordial chamber, large, the number of convolutions usually three and rarely exceeding five. Shell substance, thin, often semitranslucent. Frequently marked with corrugations, which apparently indicate periods of rest in the growth of the shell."

Originally described from the British Isles, this species has been recorded by the authors from the Mediterranean, the Kerimba Archipelago, off South Eastern Africa, from Lord Howe Island in the Pacific, and from the Antarctic.

CORNUSPIRA CRASSISEPTA H. B. Brady

Cornuspira crassisepta H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 714; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 202, pl. 113, fig. 20.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 4.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 246, pl. 3, fig. 22.—Rhumbler, Arch. Prot., vol. 3, 1903, p. 287, fig. 138 in text.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, pp. 22, 339, pl. 2, fig. 45; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 12.—Halkyard, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918 (1919), p. 18.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 392, pl. 84, fig. 1.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1924, p. 134.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 37 (table).

"Test discoidal, biconcave, peripheral edge nearly square; convolutions very numerous and very narrow near the center; spiral septal wall thick, and marked externally by a raised limbate line.

"Diameter, one-fifteenth of an inch (0.5 mm.) or rather more."

There are only a few records for the species in the Atlantic, although it was described by Brady from the Faroe Channel and no other locality given in the *Challenger* report. Since then it has been recorded as abundant as a recent and fossil species in the Australian region and elsewhere in the Pacific.

CORNUSPIRA CARINATA (Costa)

Plate 20, Figure 7

Operculina carinata Costa, Atti Accad. Pontaniana, vol. 7, fasc. 2, 1856, p. 209, pl. 17, figs. 1 A, B.

Cornuspira carinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 201, pl. 11, figs. 4 *a*, *b*.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1889, p. 484, pl. 11, fig. 6.—J. Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1889, p. 447; Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 466.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 247, pl. 3, figs. 16, 17.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 9, 1893, p. 191, pl. 5, fig. 1.—Chapman, Proc. Zool. Soc. London, 1895, p. 11.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 303, pl. 48, fig. 2.—Kiaer, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 17, 1900, p. 22.—Rhumbler, Arch. Prot., vol. 3, 1903, p. 287, fig. 140 in text.—Klähn, Mitth. nat. Ges. Colmar, vol. 14, 1916–17 (1920), p. 44, pl. 10, fig. 1.—Heron-Allen and Earland, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 217.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 11.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 392, pl. 77, fig. 6.

Test close-coiled, not flaring, coils increasing regularly in diameter; tube somewhat compressed laterally, the sides convex, peripheral margin with a thin but sharply defined keel; surface smooth except for occasional depressions marking the lines of growth; aperture broadly elliptical.

Diameter up to 3 millimeters.

This is not a common species but it seems to be widely distributed. There are numerous records from off the British Isles and the western coasts of Europe. Flint's specimens are from the Gulf of Mexico and off the northeastern coast of the United States.

CORNUSPIRA ANGIGYRA (Reuss)

Under this name Heron-Allen and Earland place a single recent specimen from dredgings west of Scotland.[11] This is apparently the only record for the species in the present ocean. Reuss described the species from the Oligocene of Germany.

CORNUSPIRA (?) DISCUS (Egger)

Biloculina discus Egger, Abhandl. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p, 217, pl. 1, figs. 50, 51.

Egger records this peculiar little species as rare from 677 meters off the West Coast of Africa. From an examination of the type in Munich, this seems to be possibly a *Cornuspira*.

[11] Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 217, pl. 40, figs. 10, 11.

Genus CORNUSPIROIDES Cushman, 1928

Cornuspiroides Cushman (Genoholotype, *Cornuspira striolata* H. B. Brady), Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 3; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 161.
Cornuspira (part) of Authors.

Test in the early stages planispiral, the coils of fairly uniform height, in the adult the height of the coil greatly increasing and no longer truly coiled but spreading out in a fan shape; interior not divided into chambers; wall calcareous, imperforate, showing distinct lines of growth; aperture in the adult very elongate, on the peripheral margin of the growing edge.

Recent. Cold water of the North Atlantic.

CORNUSPIROIDES STRIOLATA (H. B. Brady)

Plate 21, Figures 3, 4

Cornuspira striolata H. B. Brady, Proc. Roy. Soc. Edinburgh, 1882, p. 713; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 202, pl. 113, figs. 18, 19.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 107, pl. 18, fig. 835.—Rhumbler, Arch. Prot., vol. 3, 1903, p. 288, fig. 142 in text.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1913, p. 274, fig. 36 in text; British Antarctic Exped., Zool., vol. 6, 1922, p. 75.
Cornuspiroides striolata Cushman, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 1, 1928, p. 3, pl. 1, fig. 13; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 161, pl. 54, figs. 12, 13.

Test large, very much compressed, the early stages planispiral, the coils of fairly uniform height, in the adult the height of the coil very greatly increasing and no longer truly coiled but spreading out in a fan shape; interior not divided into chambers; wall calcareous, imperforate, showing distinct lines of growth and the whole surface finely striate; aperture in the adult very elongate, slit-like, on the peripheral margin of the growing edge.

Length up to nearly 25 millimeters.

Most of the records for this species are from the cold waters about the British Isles, but Heron-Allen and Earland found large specimens in their material from the Antarctic. Chapman has recorded the species from the Tertiary of Australia, but unless his specimens are very early stages, they do not seem to really belong here.

Kiaer[12] refers this to an old manuscript name *Cornuspira peneroploides* of M. Sars.

Genus CORNUSPIRELLA Cushman, 1928

Cornuspirella Cushman (Genoholotype, *Cornuspira difformis* Heron-Allen and Earland), Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 4; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 161.
Cornuspira (part) of Authors.

[12] Rep't. Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 22.

Test in the early stages planispiral, close coiled, the coils of fairly even diameter, later the height of the coil expanding and in the adult with long branching or flattened peripheral extensions; interior not divided into distinct chambers; wall calcareous, imperforate, with depressed lines of growth on the exterior; aperture in the adult elongate, narrow, at the ends of the peripheral portions.

Recent. Atlantic.

As noted by Heron-Allen and Earland, this is to be considered a specialized form and representing an end form in the *Cornuspira*-like series.

CORNUSPIRELLA DIFFUSA (Heron-Allen and Earland)

Plate 21, Figures 6, 7

Cornuspira foliacea H. B. Brady (not Philippi), Rept. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 11, fig. 7.—Rhumbler, Arch. Prot., vol. 3, 1903, p. 287, fig. 141*b* in text.

Cornuspira diffusa Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1913, p. 272, pl. 12; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 37; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 217; British Antarctic Exped., Zool., vol. 6, 1922, p. 74.

Cornuspirella diffusa Cushman, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 1, 1928, p. 4, pl. 1, fig. 14; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 161, pl. 53, figs. 16, 17.

Test in the early stages planispiral, close coiled, tubular, undivided, of fairly even diameter; later the height of the coil expanding, in the adult developing irregular branching extensions from the periphery; wall calcareous, imperforate, marked distinctly by depressed lines of growth on the exterior; aperture in the early coiled stage elongate, narrow, at the end of the coil, in the adult elongate, narrow, at the ends of the peripheral portions.

From the figures given, the diameter may be 5 millimeters or more in the branching adult form. The following notes are from the original paper by Heron-Allen and Earland.

Cornuspira diffusa is probably widely distributed in moderately deep water, on muddy bottoms, to which it appears to be everywhere confined. In addition to the few specimens first seen in Mr. Joseph Wright's dredging from Kenmare River, County Kerry (40 fathoms), we have met with occasional fragments of small size in dredgings from the area of the Clare Island (County Mayo) survey and in a shore sand from Llanfihangel-y-Traethau, in Wales.

Round the Scottish coast it is of wider distribution, occurring more or less frequently at many "Goldseeker" stations round the west coast and in Orkney and Shetland. But the species reaches its greatest development both as regard size and abundance in the fine ooze which covers the bottom in the central area of the Scottish North Sea. At some of these stations fragments of all shapes and sizes are of frequent occurence, notably at station xliA (Lat. 56° 48′ N., Long. 1° 19′ E.), 94 meters, where the specimens were particularly abundant. Remarkably fine specimens were also obtained at the "Huxley" Station 25 (5° 34′ N., 3° 53′ E.), in 37 fathoms to the south of the Inner Shoal and Great Fisher Bank in the North sea. The organism, however, is so extremely fragile that Earland did not succeed in obtaining a single perfect specimen, although at

various times he has passed several entire dredgings from this station through a fine sieve immediately after they were taken. The shells were often seen in a practically complete condition in the sieve, but invariably separated into fragments similar to those figured, either by their own weight when deprived of the supporting ooze, or as soon as an attempt was made to raise them with a brush.

There can be no doubt that the organism when undisturbed is capable of ramifying and spreading over the surface of the ooze and that it may attain a very much greater size than any of the separate fragments recovered. The protoplasm is abundant and of a dark olive tint.

In addition to the region of the British Isles, the species is recorded by the authors from the Antarctic.

Genus HEMIGORDIUS Schubert, 1908.

Hemigordius SCHUBERT (Genoholotype, *Cornuspira schlumbergeri* Howchin), Jahrb. k. k. Geol. Reichs., vol. 58, 1908, p. 381.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 161.

Cornuspira HOWCHIN (not Schlutze) Trans. Roy. Soc. South Australia, vol. 19, 1895, p. 195.

Test in the early coils not entirely planispiral, later ones planispiral and completely involute but test not umbonate; wall apparently calcareous, somewhat laminated.

Carboniferous. Australia, Japan, and America.

This is a development from the early forms of this family in which the early coils are not planispiral but become so later. The coils are involute in the adult. Such forms apparently become extinct in the Palaeozoic.

Genus VIDALINA Schlumberger, 1899

Vidalina SCHLUMBERGER (Genoholotype, *Vidalina hispanica* Schlumberger), Bull. Soc. Géol. France, ser. 3, vol. 27, 1899, p. 459.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 162

Test similar to *Cornuspira*, but completely involute, the umbonal region thickened.

Cretaceous.

This large form with its involute character is in some respects a parallelism with *Hemigordius* of the Palaeozoic, but the early development is not the same nor the character of the double wall which is developed in *Vidalina*, each coil building a floor on the preceding one. This development in *Vidalina* is a specialized one, and the genus became extinct in the Cretaceous.

Subfamily 2. NODOBACULARIINAE

Early portion as in *Cornuspira*, followed by chambers in a rectilinear series.

Genus NODOBACULARIA Rhumbler, 1895

Nodobacularia RHUMBLER (Genoholotype, *Nubecularia tibia* Jones and Parker), Nachr. Ges. Wiss. Göttingen, 1895, p. 87.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 164.

Nubecularia (part) JONES and PARKER (not Defrance), Quart. Journ. Geol. Soc., vol. 16, 1860, p. 455.

Test with a globular proloculum followed by a planispiral tubula second chamber, the adult chambers in a rectilinear series; aperture simple, with a lip.

Lias to Recent.

This genus was apparently developed early in the history of the family, and species and specimens are common in the Jurassic. There are very few living species.

NODOBACULARIA TIBIA (Jones and Parker)

Plate 21, Figure 5

Nubecularia tibia Jones and Parker, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 455, pl. 20, figs. 48–51.—H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 266, pl. 8, figs. 1, 2; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 135, pl. 1, figs. 1–4.—Haeusler, Neues Jahrb., 1887, p. 192, pl. 6, figs. 1–6.—Woodward, The Observer, vol. 4, 1893, p. 75.—A. Silvestri, Mem. Accad. Pont. Nuovi Lincei, vol. 50, 1897, p. 36.—Millett, Journ. Roy. Micr. Soc., 1898, p. 261, pl. 5, fig. 3.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 398 (list).—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 2; vol. 54, No. 16, 1910, p. 1, pl. 1, fig. 1.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 300, pl. 9, fig. 3; Trans. Zool. Soc. London, vol. 20, 1915, p. 548.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 3, pl. 1, fig. 1 (?).—Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 59.

Nodobacularia tibia Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 38, pl. 2, fig. 13.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 39, pl. 8, figs. 1, 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 415, pl. 85, figs. 2, 3; Publ. 311, Carnegie Instit. Washington, 1922, p. 59, pl. 11, fig. 1; Publ. 342, 1924, p. 53, pl. 19, fig. 10.

Test composed of a globular proloculum followed, at least in the megalospheric form, by a second *Cornuspira*-like chamber a half coil in length, in turn followed by a series of two or three or more, usually pyriform or subcylindrical chambers, the basal end being usually the broadest, tapering gradually to the apertural end; wall smooth; aperture simple, rounded, occasionally with a somewhat thickened lip.

Length usually less than 1 mm.; but Heron-Allen and Earland mention specimens 4 or 5 mm. in length. They are attached forms and may not be the same species.

For the Atlantic, there are few records. Brady gives a *Challenger* station off Culebra Island, West Indies, 390 fathoms and I have had it from the Tortugas region where it is rare. Heron-Allen and Earland record it from Selsey Bill on the southern coast of England and note its occurrence from Moray Firth, Scotland in 43 fathoms.

It seems to be more common in the Indo-Pacific in warm, shallow water.

Genus CORNUSPIRAMIA Cushman, 1928

Cornuspiramia Cushman (Genoholotype, *Nubecularia antillarum* Cushman), Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 4; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 164.

Nubecularia CUSHMAN (not Defrance), Publ. 311, Carnegie Instit. Washington, 1922, p. 58.

Test attached, in the early stages with a proloculum and one or more coils of an undivided tubular chamber about it followed by irregularly branching tubular portions with the base flattened and the upper side arched; wall calcareous, imperforate; apertures formed by the open ends of the tubes.

Recent. Tropical, in shallow water.

CORNUSPIRAMIA ANTILLARUM (Cushman)

Plate 21, Figures 1, 2

Nubecularia antillarum CUSHMAN, Publ. 311, Carnegie Instit. Washington, 1922, p. 58, figs. 7, 8 in text.

Cornuspiramia antillarum CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 164, pl. 55, figs. 1, 2.

Test attached, early portion consisting of a proloculum and one or two chambers, forming a single coil, the main portion of the test consisting of an irregular branching tube, slightly convex, with an irregular periphery, spreading over the surface of the test to which it is attached; aperture at the ends of the branches.

The species is commonly found attached to the short eel grass, *Posidonia*, in shallow sandy areas in the tropical West Indian region. It was found at Jamaica and at the Tortugas under similar conditions so is probably widely distributed in such habitats.

It is evidently a deriative from a *Cornuspira*-like ancestry which has become very widely spreading into tubular masses due to the attached habit. The spreading tubes may cover an area of several millimeters. They are flattened on the attached side and gently convex on the other. As all stages were seen on a single leaf of *Posidonia*, the development must be a rapid one.

Subfamily 3. OPHTHALMIDIINAE

Test free, planispiral, in the later stages usually two or more chambers making up a coil, later chambers variously arranged in different genera.

Genus OPHTHALMIDIUM Zwingli and Kübler, 1870

Ophthalmidium ZWINGLI and KÜBLER (Genotype, by designation, *Ophthalmidium porosum* Zwingli and Kübler), Foram. Schweiz. Jura, 1870, p. 46.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 188.—CHAPMAN, The Foraminifera, 1902, p. 97.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 165.

Hauerina (part) H. B. BRADY (not d'Orbigny), Quart. Journ. Micr. Sci., vol. 19, 1879, p. 268.

Hauerinella SCHUBERT, Pal. Zeitschr., vol. 3, 1920, p.162 (genoholotype, *Ophthalmidium inconstans* H. B. Brady).

Test planispiral, compressed, not involute, consisting of a globular proloculum followed by a planispiral tubular chamber of usually two

or more coils, the following chambers decreasing in relative length, loose coiled, the intermediate area filled with a thin, shelly plate; aperture at the open end of the chamber, rounded, without lip or tooth.

Jurassic to Recent.

This is a genus which has persisted since the Jurassic and is to be considered primitive in many ways. The early stages connect it with *Cornuspira*, the later chambers adding a new development that is modified in the succeeding genera.

OPHTHALMIDIUM INCONSTANS (H. B. Brady)

Plate 21, Figures 8–11

Hauerina inconstans H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 268.

Ophthalmidium inconstans H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 189, pl. 12, figs. 5, 7, 8.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 63 (list).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 216, pl. 40, figs. 12, 13.—Chaster, First Rept. Southport Soc. Nat. Sci., 1890–91 (1892), p. 56.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 465.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 244, pl. 3, figs. 6, 49.—Chapman, Proc. Zool. Soc. London, 1895, p. 11.—Flint, Ann. Rept. U. S. Nat. Mus., 1897 (1899), p. 302, pl. 47, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1898, p. 608.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 398; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 8, 28, pl. 3, figs. 1–4, fig. 6 in text.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 10, pl. 2, figs. 5–8.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 393, pl. 78, figs. 2, 3.—Hanzawa, Jap. Journ. Geol. Pal., vol. 4, 1925 (1926), p. 37 (table).

Ophthalmidium tumidulum H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 189, pl. 12, fig. 6.—Woodward, The Observer, vol. 4, 1893, p. 77.—Millett, Journ. Roy. Micr. Soc., 1898, p. 608, pl. 13, fig. 2.—Kiaer, Rept. Norwegian Fish. Mar. Invest., vol. 1, No. 7, 1900, p. 29.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399 (list).—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 28, pl. 3, fig. 5.

Test planispiral, much compressed, chambers consisting of a globular proloculum, followed by a *Cornuspira*-like coiled second chamber, making two or more coils, this in turn followed by chambers progressively relatively shorter in length until the adult condition is reached, where chambers are half a coil in length or less; chambers nearly circular in transverse section with a thin wide flange on the peripheral border, chambers often slightly less coiled toward the apertural end, leaving a space filled by a thin plate of calcareous material; aperture circular without lip or teeth.

Diameter up to 1.5 millimeters.

This is a widely distributed species from the records, usually in fairly deep water. In the Atlantic there are records from about the British Isles, off the coasts of the United States, off the Abrohlos Bank, and in deeper water.

Ophthalmidium inconstans—material examined

Catalogue No.	Collection of—	Number of specimens	Station	Locality	Depth in fathoms	Bottom temperature	Character of bottom	Abundance
20743	U.S.N.M.	1	D2756---	° ′ ″ ° ′ ″ 3 22 00 S.; 37 49 00 W---	417	40.5	gy.bk.sp.---	Rare.

OPHTHALMIDIUM CARINATUM Balkwill and J. Wright

Ophthalmidium carinatum Balkwill and J. Wright, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 326, pl. 12, figs. 13–16.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 465.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 34; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 215.

"Shell much compressed, subdiscoidal, equilateral, showing all the convolutions; peripheral margin with a narrow keel, composed of a few convolutions slightly embracing; segments few, swollen at the base and getting narrower toward the superior end, each forming about two-thirds of a convolution; aperture simple, terminal."

This seems to be a fairly constant species in its restricted habitat about the British Isles. I have not seen material and nothing like it has occured in the collections from the western side of the Atlantic which I have examined.

Genus SPIROPTHALMIDIUM Cushman, 1927

Spiropthalmidium Cushman (Genoholotype, *Spiroculina acutimargo* H. B. Brady (part)), Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 37; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 165.

Spiroloculina (part) H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 154.

Test similar to *Ophthalmidium*, but accelerated, the stage having two chambers in a coil quickly reached; plate between the chambers usually present; aperture simple, without teeth.

Lias to Recent.

This seems to be somewhat of a left-over from older periods as are *Ophthalmidium* and *Discospirinia*. There are very few living forms. There is a strong resemblance to *Spiroloculina*, but the developmental stages are different and there is no apertural tooth.

SPIROPTHALMIDIUM ACUTIMARGO H. B. Brady

Plate 22, Figure 1

Spiroloculina acutimargo H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 154, pl. 10, fig. 13 (not figs. 12, 14, 15).—Balkwill and J. Wright, Trans. Roy. Irish Acad., vol. 28, Sci., 1885, p. 323.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 72 (list).—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 59.—Chaster, First Rept. Southport Soc. Nat. Sci., 1890–91 (1892), p. 55.—J. Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 463.—Millett, Journ. Roy. Micr. Soc., 1898, p.

264.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 172.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 6.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 192.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 119.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 396.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 24, pl. 1, fig. 8.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 6.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 557; Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 208.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 31, pl. 5, fig. 1.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 5.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 398; Publ. 342, Carnegie Instit. Washington, 1924, p. 56.

Spiropthalmidium acutimargo Cushman, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 37, pl. 8, fig. 5; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 165, pl. 20, fig. 7; pl. 21, fig. 5.

Test oval, much compressed, planispiral throughout, peripheral margin carinate; development consisting of a proloculum followed by several coils of an undivided second tubular chamber, then by chambers a half coil in length separated by a wide flange; wall smooth; aperture rounded, without a tooth.

Length, 0.75 mm.; breadth, 0.50 mm.; thickness, 0.08 mm.

There are records for this species from *Challenger* stations off Bermuda and from the South Atlantic as well as from several stations about the British Isles. As Brady included four species under this name, the records based upon his figures are very doubtful. Some have been excluded as it is definite that they do not refer to the typical form, but most of the others are given above to call attention to them whenever it may be possible to straighten them out from the original collections. I have some beautiful specimens of the form of this species as it occurs about the British Isles through the kindness of Earland. They are from Station 7 of the third cruise of the *Porcupine*, 48° 18′ N., 9° 11″ W., in 93 fathoms. They show very clearly the development of the species and a striking resemblance to Jurassic forms.

SPIROPTHALMIDIUM ACUTIMARGO (H. B. Brady), var. CONCAVA (Wiesner)

Plate 22, Figures 2*a–c*

Spiroloculina acutimargo H. B. Brady, var. *concava* Wiesner, Zool. Anzeiger, vol. 41, 1913, p. 521.—Heron-Allen and Earland, Trans. Linn. Soc. London, ser. 2, vol. 11, 1916, p. 208, pl. 39, figs. 1–3.

Variety differing from the typical in the shape of the test which instead of being flattened is deeply concave on one side and convex on the other.

Heron-Allen and Earland give the following notes on this species:

Wiesner in his paper (*ut supra*) records this beautiful little variety, and so far as we are aware, it has not been figured or described in print. He was good enough to send us specimens of his variety from the Adriatic Sea, and its

occurrence in these dredgings is very noteworthy. As will be seen from our figure, the variety is very striking and distinctive, being strongly convex on the one side and correspondingly concave on the other. The whole test is exceedingly thin and delicate in structure. The line of curvature is in the direction of the short axis of the shell. Wiesner regards his specimens as a variety of *S. acutimargo* Brady; from the curvature of the chambers it might equally be regarded as allied to *S. tenuis*. The reason for the curvature of the chambers is entirely obscure; it may possibly be due to the specimens growing adherent to algae in the earlier stages of growth.

Heron-Allen and Earland give a record of a single specimen from off the west coast of Scotland, but Earland has very kindly sent me a beautiful series of this variety from Porcupine Station 7, third cruise, 48° 18′ N.; 9° 11′ W. in 93 fathoms. They have every indication of having been attached.

It is quite probable that the *Spiroloculina tenuiseptata* of H. B. Brady may belong in this genus, but a further study is necessary to definitely place this species. It occurs widely distributed and excellent specimens are from off the British Isles as well as from the Mediterranean and Indo-Pacific.

Genus DISCOSPIRINIA Munier-Chalmas, 1902

Discospirinia Munier-Chalmas (Genotype, by designation, *Orbitolites tenuissima* W. B. Carpenter), Bull. Soc. Géol. France, ser. 4, vol. 2, 1902, p. 352.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 165.

Cyclophthalmidium Lister, in Lankester, A Treatise on Zoology, pt. 1, fasc. II, 1903, p. 110 (footnote) (genoholotype, *Orbitolites tenuissima* W. B. Carpenter).

Orbitolites (part) of Authors.

Test in the young similar to *Ophthalmidium*, later chambers annular with incomplete divisions into chamberlets; apertures at the periphery of the very thin test.

Tertiary and Recent.

DISCOSPIRINIA TENUISSIMA (W. B. Carpenter)

Orbitolites tenuissimus W. B. Carpenter, Proc. Roy. Soc., vol. 18, 1869, p. 421; vol. 19, 1870, p. 155; in Wyville Thomson, Depths of the Sea, 1873, p. 91, text fig. 10.—Norman, Proc. Roy. Soc., vol. 25, 1876, p. 211.—W. B. Carpenter, The Microscope, ed. 6, 1881, p. 556, text fig. 318.—Schlumberger, Feuille des Jeunes Nat., 1882, pl. 3, fig. 1.—Folin, Congres Sci., Dax, 1882 (1883), p. 314, pl., fig. 5.—W.B. Carpenter, Phil. Trans., vol. 174, 1883, p. 553, pls. 37, 38; Rep. *Challenger* "*Orbitolites*," 1883, p.16, pls. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 212, pl. 15, figs. 6 *a–d*, 7.—J. Wright, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1889, p. 447.—Woodward, The Observer, vol. 4, 1893, p. 78.—Flint, Ann. Rep't. U. S. Nat. Mus., 1897 (1899), p. 305, pl. 52.

Orbitulites tenuissima Abich, Geol. Forsch. Kaukas. Ländern, 1882, p. 243, fig. 41.

Discospirinia tenuissima Munier-Chalmas, Bull. Soc. Geol. France, ser. 4, vol. 2, 1902, p. 352.—Cushman, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 37, pl. 8, fig. 6; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 165, pl. 20, fig. 8; pl. 21, fig. 6.

Cyclophthalmidium tenuissima LISTER, in Lankester, A Treatise on Zoology, pt. 1, fasc. 2, 1903, p. 110 (footnote).

This species has been excellently figured in the Monographs of Carpenter, by Brady and by Flint. It occurs in fairly deep water of the North Atlantic and apparently in the Mediterranean. The development is very interesting and shows the relationship of the genus to *Ophthalmidium*. Its resemblance to *Orbitolites* is only superficial and the structure of the two is very different.

I have some young stages kindly sent me by Earland from off the British Isles, and there are complete specimens in the *Albatross* collection from the North Atlantic studied by Flint.

The *Pavonina italica* figured by Costa[13] evidently is a *Discospirinia*, but whether the same species or not it is very difficult to say without seeing the actual type specimens, the figures like most of those of Costa's being poorly drawn when details are needed.

Genus PLANISPIRINA Seguenza, 1880

Planispirina SEGUENZA (Genotype, by designation, *Planispirina communis* Seguenza), Atti R. Accad. Lincei, ser. 3, vol. 6, 1880, p. 310.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 193 (in part).—CHAPMAN, The Foraminifera, 1902, p. 98.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 166.

Test in the early stages like *Cornuspira*, later divided into chambers, several to a coil; aperture simple, without a tooth.

Cretaceous to Recent.

PLANISPIRINA CLIARENSIS Heron-Allen and Earland

Planispirina cliarensis HERON-ALLEN and EARLAND, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 35, pl. 2, figs. 7, 8; British Antarctic Exped., Zool., vol. 6, 1922, p. 73.

"Test minute, compressed, highly polished, with two chambers visible on the inferior surface and three or four on the superior or oral surface. Periphery acute, and, in young specimens, carinate. Aperture a large, edentate, circular or ear-shaped opening at the termination of the final chamber, opening laterally upon the flat surface of the test, surrounded in most instances by an everted and rounded lip. The earliest chamber is an unseptate spiral coil.

"Length, 0.15–0.25 mm.; breadth, 0.12–0.18 mm."

This small species was described from the Clare Island region of Ireland where it occurs in some numbers. The authors also record it from the Antarctic.

PLANISPIRINA AURICULATA Egger

Plate 22, Figure 3

Planispirina auriculata EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 245, pl. 3, figs. 13–15.—HERON-ALLEN and EARLAND,

[13] (Atti Accad. Pont., vol. 7, 1856, p. 178, pl. 16, figs. 26–28.)

Trans. Zool. Soc. London, vol. 20, 1915, p. 590, pl. 46, figs. 3–7.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 10.—Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 62, pl. 10, fig. 8.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 609.

Test minute, generally oval in outline, biconvex, consisting of a few milioline chambers, the apertural end somewhat extended, turned so that the aperture is entirely at one side of the test; aperture elliptical or rounded, with a broad, flaring lip; sutures fairly distinct not depressed; wall translucent; color, bluish-white.

Length, 0.20 mm.; breadth, 0.15 mm.; thickness, 0.08 mm.

Egger described this species from the Indo-Pacific where it has been found several times since. The only record from the Atlantic seems to be that from the Tortugas. I have seen specimens from off Beaufort, on the Carolina coast, and so it must have a fairly wide distribution in the West Indian region. Its small size makes it easily overlooked.

PLANISPIRINA COMMUNIS Seguenza

Planispirina communis Seguenza, Atti Accad. Lincei, ser. 3, vol. 6, 1880, p. 310, pl. 17, figs. 18, 18*a*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 196, pl. 114, figs. 4–7.—Egger, Abhandl. kön. bay. Akad. Wiss., Cl. II, vol. 18, 1893, pl. 3, figs. 25, 26.—Woodward, The Observer, vol. 4, 1893, p. 77.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399 (list).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 591, pl. 46, figs. 8,9.

Test bilaterally symmetrical, early portion with a proloculum and close coiled, tubular chamber making several coils, after which chambers of gradually shorter lengths are formed, until, in the adult, four or or more chambers make up a coil; sutures obscure, due to the involute character of the chambers; wall smooth; aperture simple, elongate, without a tooth.

There are but few records for this species. It occurs in the Atlantic off the Faroe Islands, 170 fathoms according to Brady, and Woodward mentions it from off Bermuda. The other recent records are from the Indo-Pacific.

In the adult there is a tendency for the test to uncoil.

PLANISPIRINA EXIGUA (H. B. Brady)

Hauerina exigua H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 53.
Planispirina exigua H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 196, pl. 12, figs. 1–4, text fig. 5 *b*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 216, pl. 40, fig. 4.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 5.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 245, pl. 3, figs. 11, 12.—Woodward, The Observer, vol. 4, 1893, p. 77.—Millett, Journ. Roy. Micr. Soc., 1898, p. 611, pl. 13, fig. 13.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 21, pl. 2, fig. 43; Subantarctic Islands of New Zealand, 1909, p. 323.—Heron-Allen and Earland, Trans. Zool.

Soc. London, vol. 20, 1915, p. 590.—Chapman, Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 9, fig. 7, in text.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1924, p. 133.

"Test free, thin, discoidal, planospiral; composed of a number of convolutions of a narrow, slightly embracing tube. Convolutions five to eight in number, the earlier whorls nonseptate, as in *Cornuspira;* those subsequently formed each divided into two or three segments; the spiral suture and septa alike obscured externally by the alar extensions of the investing wall over the lateral surfaces of the shell. Aperture a simple terminal slit. Diameter, one-fiftieth of 1 inch (0.5 mm.) or less."

There seems to be very little difference between this and Seguenza's species. The Atlantic records include stations off Bermuda and West Africa, but most of the records are from the shallow water of the Indo-Pacific.

Genus RENULINA Lamarck, 1804

Renulina Lamarck (Genoholotype, *Renulina opercularia* Lamarck), Ann. Mus., vol. 5, 1804, p. 354.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 166.

Test in the early stages planispiral, in the adult chambers becoming relatively shorter and broader, one side of the test nearly a straight line, the opposite end extending back to the earlier coils, in final stages of complete specimens the chambers extending back to the earlier coils on both ends and becoming annular.

Eocene.

This genus which is a specialized one, greatly spreading in its later development, and finally ending in annular chambers is an end development which became extinct with the Eocene.

Genus VERTEBRALINA d'Orbigny, 1826

Vertebralina d'Orbigny (Genoholotype, *Vertebralina striata* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 283.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 186.—Chapman, The Foraminifera, 1902, p. 97.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 168.

Test with the early chambers planispiral, later ones in a rectilinear series; aperture simple, a long narrow slit either at the outer end of the chamber or somewhat laterally placed, typically with a definite lip.

Eocene to Recent.

The species of this genus have the early stages planispiral, but owing to the involute character it is often difficult to see the complete stages without sections. The species are best developed in warm, shallow waters of coral reefs.

VERTEBRALINA CASSIS d'Orbigny

Plate 22, Figures 4 *a*, *b*

Vertebralina cassis D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 51, pl. 7, figs. 14, 15.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64, pl. 15, figs. 1, 4 (not 2, 3, 5–8): Publ. 311, Carnegie Instit. Washington, 1922, p. 262.

Test compressed, for the most part planispiral; periphery of each chamber with a broad, thin keel, two to three chambers in the last-formed coil, the main body of each chamber with numerous, somewhat oblique costae, the last-formed chamber often projecting beyond the periphery of the preceding coil, but carinate, like the earlier ones; aperture elongate, with a distinct, everted lip; early chambers, where visible, spiroloculine.

Length, 1.10 mm.; breadth, 1 mm.; thickness, 0.15 mm.

This species is common in the warm shallow waters of the West Indian region but seems to be largely limited to this region. It is a beautifully ornamented species. The early chambers become somewhat involute, obscuring the stages of the early development.

VERTEBRALINA CASSIS d'Orbigny, var. MUCRONATA d'Orbigny

Plate 22, Figure 5

Vertebralina mucronata D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 72, pl. 7, figs. 16–19; Foram. Foss. Vienne, 1846, p. 120, pl. 21, figs. 18, 19.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64, pl. 15, figs. 2, 3, 5–8 (not 1, 4).

Vertebralina cassis D'ORBIGNY, var. *mucronata* CUSHMAN, Publ. 311, Carnegie Instit. Washington, 1922, p. 63; Publ. 344, 1926, p. 81.

Test of the early portion close-coiled, usually without a carina, the uncoiled portion consisting in the adult usually of two chambers, compressed, the last one much broader than the preceding, the apertural end with an everted lip extending back on both sides to a recurved projection; surface ornamented with numerous raised costae, somewhat shiny; color white.

This nonkeeled, less expanded variety occurs usually with the typical form.

VERTEBRALINA STRIATA d'Orbigny

Plate 22, Figures 6 *a*, *b*

Vertebralina striata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 283, No. 1. Modèles, No. 81.—WILLIAMSON, Rec. Foram. Gt. Britain, 1858, p. 90, pl. 7, figs. 196 *a*, *b* (=197, 198).—W. B. CARPENTER, PARKER, and JONES, Introd. Foram., 1862, p. 72, pl. 5, figs. 17–25.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 32, pl. 1, fig. 1; ser. 4, vol. 8, 1871, p. 239, pl. 8, fig. 27.—SCHWAGER, Boll. Comm. Geol. Ital., vol. 8, 1877, p. 27, pl., fig. 106.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 187, pl. 12, figs. 14–16.—A. SILVESTRI, Atti Accad. Sci. Acireale, vol. 7, 1896, p. 22.—MILLETT, Journ. Roy. Micr. Soc., 1898, p. 607, pl. 13, fig. 1.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos.

Soc., vol. 48, No. 5, 1904, p. 18.—Dakin, Rept. Pearl Oyster Fish. Ceylon, 1906, p. 231.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 125.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 6.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 305; Trans. Zool. Soc. London, vol. 20, 1915, p. 587.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 38, pl. 22, figs. 3, 4; Publ. 291, Carnegie Instit. Washington, 1919, p. 69, pl. 14, fig. 3.—Martinotti, Atti Soc. Ital. Sci. Nat., vol. 59, 1920, p. 327, fig. 170 in text.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 414.—Heron-Allen and Earland, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123.

Test much compressed, early portion close coiled, later uncoiling in a series of low, broad, uniserial chambers; sutures distinct, depressed; surface ornamented by fine longitudinal striae; aperture elongate, irregular, the lip on one side being shorter than on the other, making the aperture really on the ventral side of the test, lip smooth, ends rounded and not projecting.

Length up to 1.2 mm.; breadth, 0.60 mm.; thickness, 0.20 mm.

Not all the specimens recorded under this species seem to be identical with d'Orbigny's. It is to be suspected that this is a species of the Mediterranean, Indo-Pacific, and the eastern Atlantic replaced in the West Indian region by *V. cassis*.

VERTEBRALINA INSIGNIS H. B. Brady

Vertebralina insignus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 187, pl. 12, figs. 9–11.—Howchin, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 5.—Flint, Ann. Rept. U. S. Nat. Mus., 1897 (1899), p. 302, pl. 47, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 123.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 39, pl. 22, figs. 1, 2.

"Test compressed, planospiral, subquadrangular, nearly symmetrical bilaterally; margin angular or partially carinate. Segments few, more or less triangular in outline, embracing the three segments of the final convolution (with or without a single additional or nonspiral segment) forming almost the entire visible shell. Surface decked with exogenous costae, either distinct or in some parts combined so as to form an irregular reticulated ornament. Aperture a long bordered slit on the median line of the outer face of the terminal chamber.

"Length one-twenty-fifth of 1 inch (1 mm.)."

Brady's only Atlantic record for this species is a *Challenger* station off Culebra Island, West Indies, 390 fathoms. Flint's *Albatross* stations are from the Gulf of Mexico, the coast of Florida, and off Chesapeake Bay, 60 to 169 fathoms.

This may possibly be the early stage of a species with more uniserial chambers.

Subfamily 4. Nubeculariinae

Test typically attached, at least in the early stages, coiled in the young, later irregular or consisting of a single attached chamber.

Genus NUBECULARIA Defrance, 1825

Nubecularia Defrance (Genoholotype, *Nubecularia lucifuga* Defrance), Dict. Sci. Nat., vol. 35, 1825, p. 210.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 133.—Chapman, The Foraminifera, 1902, p. 81.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928 p. 168.

Amorphina Parker, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 278 (fide Sherborn).

Test typically coiled, planispiral, free or usually attached, consisting of an oval proloculum, with a second coiled tubular chamber followed in the adult by irregular chambers varying more or less with the attached surface.

Lias to Recent.

This genus now most abundant in shallow warm waters of the Tropics is planispiral, although due to its attachment it frequently builds up material on the outer surface making an asymmetrical test.

NUBECULARIA INFLATA Terquem

Under this name Terquem[14] describes and figures a peculiar attached form from the coast of France. It has four or five irregular chambers in the last coil. It is not elsewhere recorded. This is not the same as the later *N. inflata* Brady (=*Silvestria bradyi* (Millett)).

NUBECULARIA LUCIFUGA Defrance

This species described by Defrance from the Eocene of the Paris Basin is recorded in so many forms that it is almost hopeless to try and untangle the synonymy without recourse to the original specimens. Brady in the *Challenger* report mentions that the species occurs in the West Indies, but I have failed to find specimens there that I could refer to Defrance's species. There are several records from the region of the British Isles. Earland[15] figures the early *Cornuspira* stage from specimens from shore sand at Bognor, Sussex, England.

Genus CALCITUBA Roboz, 1883

Calcituba Roboz, (genoholotype, *Calcituba polymorpha* Roboz), Sitz. Akad. Wiss. Wien, vol. 88, pt. 1, 1883 (1884), p. 420.—Chapman, The Foraminifera, 1902, p. 80.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 168.

Test adherent, branched, of irregular chambers, more or less cylindrical; wall imperforate; apertures simple, at the ends of the branches.

Recent. Pacific and Mediterranean.

This species is known from the Mediterranean, and I have had it also from the Pacific.

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[14] Essai Class. Anim. Dunkerque, 1876, p. 73, pl. 8, figs. 10 *a–c*.

[15] Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, pl. 1, figs. 2, 3.

Genus SILVESTRIA Schubert, 1920

Silvestria Schubert ((genoholotype, *Nubecularia inflata* H. B. Brady not Terquem), *N. bradyi* Millett), Pal. Zeitschr., vol. 3, 1920, p. 166.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 169.
Nubecularia (part) of Authors.

Test with the early chambers similar to *Calcituba*, the later ones inflated, irregularly coiled; wall calcareous, imperforate; aperture rounded, irregularly placed.

Recent.

SILVESTRIA BRADYI (Millett)

Nubecularia inflata H. B. Brady (not Terquem, 1876), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 135, pl. 1, figs. 5–8.—A. Silvestri, Atti Accad. Sci. Acireale, vol. 7, 1895–96, p. 30; Mem. Accad. Pont. Nuovi Lincei, vol. 50, 1897, p. 35.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 116.
Nubecularia bradyi Millett, Journ. Roy. Micr. Soc., 1898, p. 261, pl. 5, figs. 6 *a*, *b*.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 169, pl. 19, fig. 3.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 3.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 119.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 2.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1911, p. 300.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 993.—Chapman, Victorian Nat., vol. 32, 1915, p. 49, text fig. 1.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 550, pl. 40, figs. 8–10.—Cushman, Proc. U. S. at. Mus., vol. 56, 1919, p. 636.—Martinotti, Atti Soc. Ital. Sci. Nat., vol. 59, 1920, p. 253.—Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 60; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 601; Trans. Zool. Soc. London, vol. 22, 1926, p. 68 (list).
Silvestria bradyi Schubert, Pal. Zeitschr., vol. 3, 1920, p. 166.

Chambers in the early stages coiled, later ones irregular, inflated; wall calcareous, imperforate; aperture rounded or variously shaped, without a tooth.

Specimens have been referred to this species from the coast of England by Heron-Allen and Earland. It is much more common in the Mediterranean and the Indo-Pacific.

Genus SQUAMULINA Schultze, 1854

Squamulina Schultze (Genoholotype, *Squamulina laevis* Schultze), Organismus Polythal., 1854, p. 56.—Chapman, The Foraminifera, 1902, p. 79.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 169.

Test adherent, consisting of a single inflated chamber with the wall calcareous and imperforate; aperture simple, on the convex surface.

Recent.

This is a degenerate form which from the character of the wall seems to belong with this family. It is known only as a recent species.

SQUAMULINA LAEVIS Schultze

There is an Atlantic record for this species given by Siddall,[16] "Colwyn Bay, on Zoophytes, very rare." The types were from Ancona.

Under this genus Carter described two species from the "Beach at Budleigh—Salterton, Devonshire; cast ashore by storms." These were attached to algae. They are *Squamulina scopula* Carter[17] and *S. varians* Carter.[18] It is very doubtful if either of these has any affinities with *Squamulina*.

Family 18. FISCHERINIDAE

Test coiled, earlier ones somewhat planispiral, later ones trochoid, all coils visible from the dorsal side only, the last-formed one from the ventral side; chambers distinct but not inflated, usually four or five making up the last-formed coil; wall calcareous, imperforate; aperture rounded, formed by the open end of the last-formed chamber.

This family represented by the single genus *Fischerina* represents the attempt in fairly recent times of the assuming of a trochoid form. It is surprising that this trochoid form taken on by many groups has never been successfully tried out by the vitreous or porcellaneous groups.

Genus FISCHERINA Terquem, 1878

Fischerina Terquem (Genoholotype, *Fischerina rhodiensis* Terquem), Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 80.—Cushman, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 170.

Test coiled in a low conical spiral; chambers few in each coil, all visible from the dorsal side, only those of the last-formed coil from the ventral side; wall calcareous, imperforate; aperture formed by the open end of the last-formed chamber, simple.

Pliocene to Recent.

The species of this genus are mostly confined to shallow warm water of the Tropics.

FISCHERINA DUBIA (d'Orbigny)

Plate 22, Figures 7, 8

Rotalina dubia d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 91, pl. 2, figs. 29, 30; pl. 3, fig. 1.

Fischerina dubia Cushman, Publ. 311, Carnegie Instit. Washington, 1922, p. 59, pl. 10, figs. 6, 7.

Test composed of a few coils, the early portion undivided, the last-formed coil divided into four or five chambers, all visible from the

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Proc. Lit. Phil. Soc. Liverpool, 1886, p. 61 (list).

[17] Ann. Mag. Nat. Hist., ser. 4, vol. 5, 1870, p. 310, pl. 4, figs. 1–11.

[18] Idem, p. 321, pl. 5, figs. 1–5.

dorsal side, from the ventral only those of the last-formed coil visible, as the chambers extend into the middle at the umbilical region; ventral side somewhat concave, dorsal side convex; sutures distinct; wall thin and translucent; aperture at the end of the last-formed chamber, usually circular.

Diameter of Tortugas specimens up to 0.30 millimeter.

The following notes were given in the Tortugas paper above referred to: A comparison of d'Orbigny's figures in the Cuban monograph will show that his *Rotalina dubia* really belongs to *Fischerina* and allowing for reasonable differences in the figures, our specimens from the Tortugas are undoubtedly the same as those d'Orbigny had from the shore sands of Cuba and Jamaica. D'Orbigny's specimens evidently did not show the aperture, as his figures do not show this feature and his description refers to it with a question mark. From the ventral side, *Fischerina dubia* is nearest to *F. helix* Heron-Allen and Earland, which they described from the Kerimba Archipelago. It is not common at the Tortugas.

PLATES

Plate 1

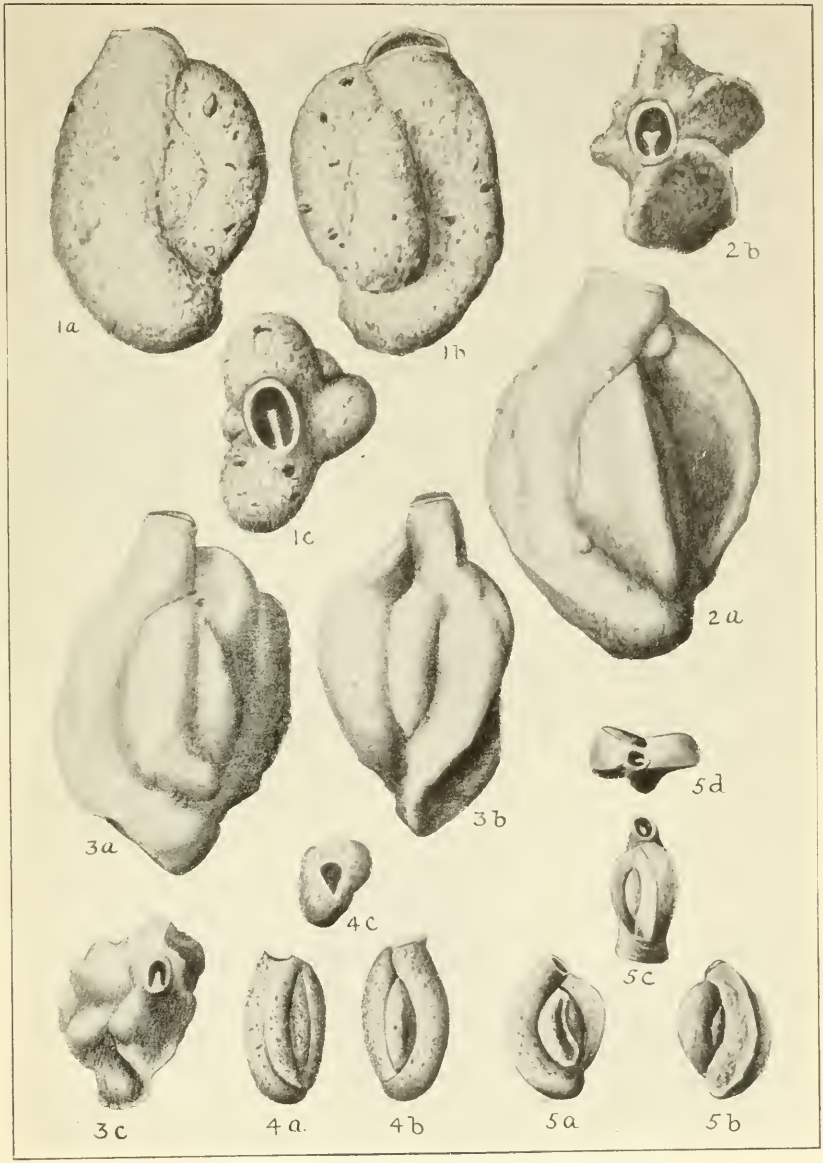
Figure 1. *Quinqueloculina agglutinans* d'Orbigny. × 40. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

2. *Quinqueloculina bidentata* d'Orbigny. × 40. Tortugas. *a*, Side view; *b*, apertural view.

3. *Quinqueloculina bradyana* Cushman. × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

4. *Quinqueloculina fusca* H. B. Brady. After type figures. *a*, *b*, opposite sides; *c*, apertural view.

5. *Quinqueloculina sclerotica* Karrer. After Balkwill and Millett. *a*, *b*, opposite sides; *c*, peripheral view; *d*, apertural view.



MILIOLIDAE OF THE ATLANTIC OCEAN

FOR EXPLANATION OF PLATE SEE PAGE 102

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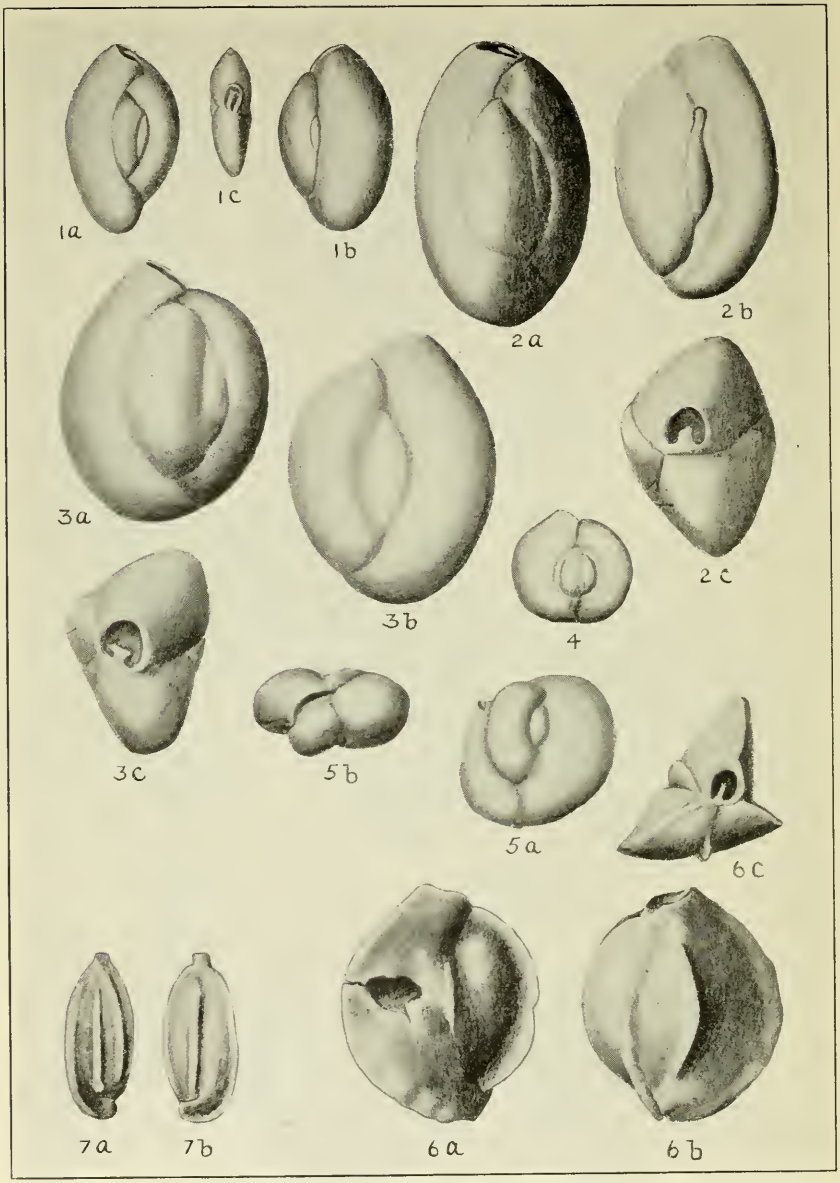


MILIOLIDAE OF THE ATLANTIC OCEAN

FOR EXPLANATION OF PLATE SEE PAGE 103

Plate 2

Figure 1. *Quinqueloculina seminulum* (Linnaeus). After Williamson. *a*, *b*, opposite sides; *c*, apertural view.

2. *Quinqueloculina seminulum* (Linnaeus). × 60. From *Lord Bandon*, log. 42, off S. W. Ireland. *a*, *b*, opposite sides; *c*, apertural view.

3. *Quinqueloculina vulgaris* d'Orbigny. × 60. From Kiollie Fjord, 4 fathoms. *a*, *b*, opposite sides; *c*, apertural view.

4. *Quinqueloculina subrotunda* (Montagu). × 40. After H. B. Brady.

5. *Quinqueloculina dilatata* d'Orbigny. × 60. Tortugas. *a*, side view; *b*, apertural view.

6. *Quinqueloculina lamarckiana* d'Orbigny. × 40. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

PLATE 3

FIGURE 1. *Quinqueloculina candeiana* d'Orbigny. × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

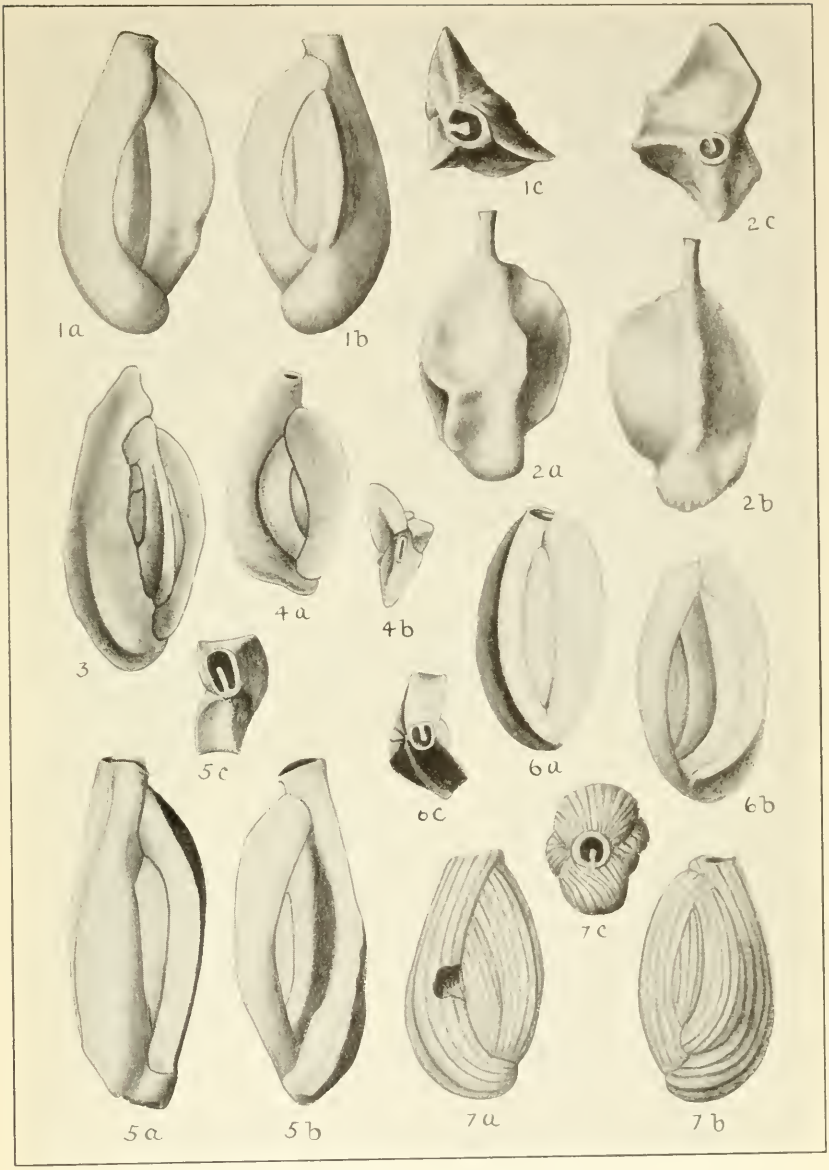
2. *Quinqueloculina collumnosa* Cushman. × 40. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

3, 4. *Quinqueloculina stelligera* Schlumberger. × 60. After Heron-Allen and Earland. *a*, side view; *b*, apertural view.

5. *Quinqueloculina polygona* d'Orbigny. × 70, Tortugas, *a*, *b*, opposite sides; *c*, apertural view.

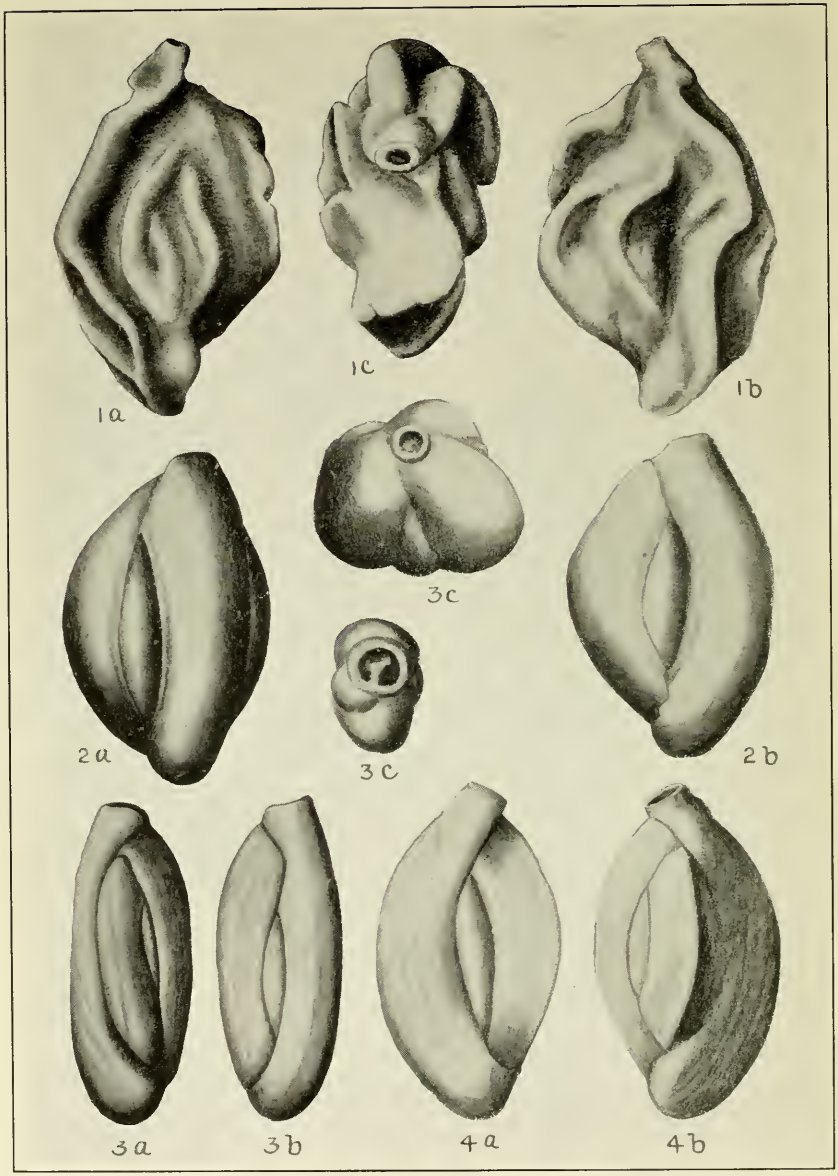
6. *Quinqueloculina contorta* d'Orbigny. After d'Orbigny. Specimen from Miocene of Vienna Basin. *a*, *b*, opposite sides; *c*, apertural view.

7. *Quinqueloculina costata* d'Orbigny. × 60. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.



MILIOLIDAE OF THE ATLANTIC OCEAN

FOR EXPLANATION OF PLATE SEE PAGE 104



MILIOLIDAE OF THE ATLANTIC OCEAN

FOR EXPLANATION OF PLATE SEE PAGE 105

Plate 4

Figure 1. *Quinqueloculina tricarinata* d'Orbigny. × 60. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

2. *Quinqueloculina striata* d'Orbigny. × 60. Tortugas. *a*, *b*, opposite sides; *c*, apertural view; 3*c*, upper figure.

3. *Quinqueloculina laevigata* d'Orbigny. × 60. Tortugas. *a*, *b*, opposite sides; *c*, apertural view; 3*c*, lower figure.

4. *Quinqueloculina funafutiensis* (Chapman). × 89. Tortugas. *a*, *b*, opposite sides.

Plate 5

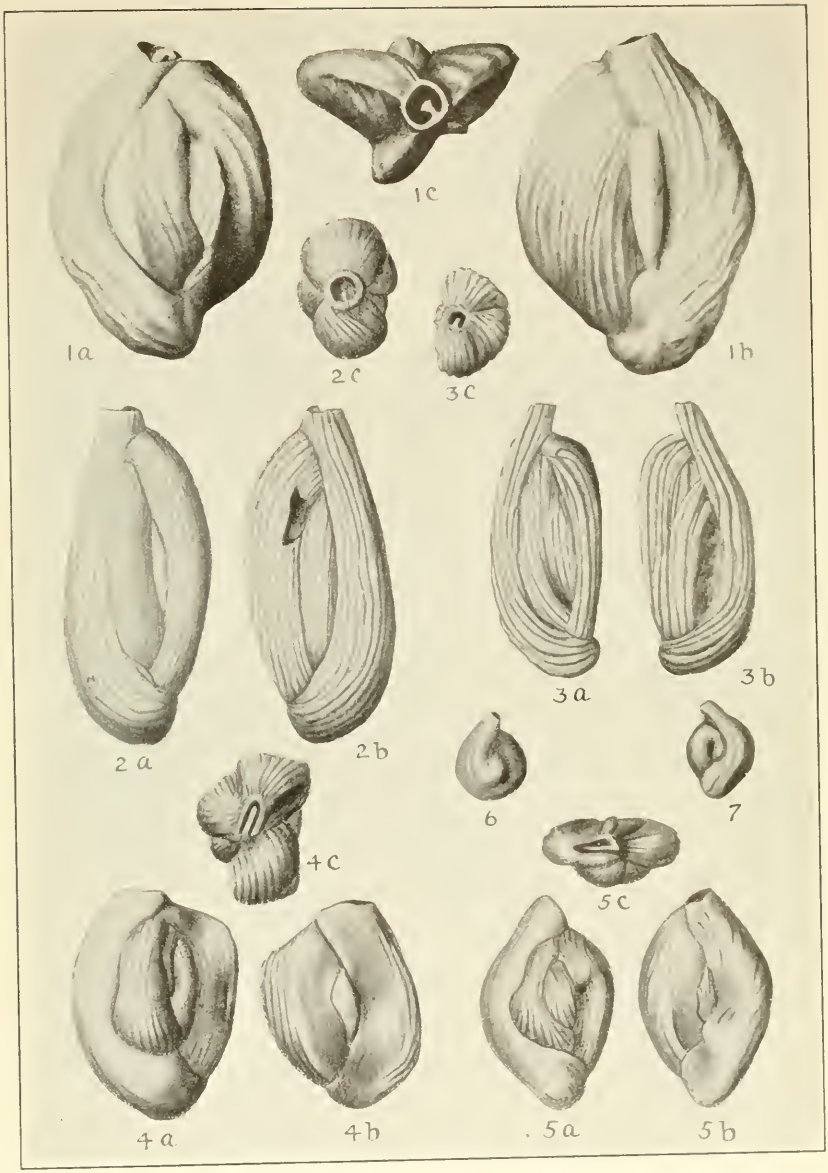
Figure 1. *Quinqueloculina crassa* d'Orbigny, var. *subcuneata* Cushman. × 60. Porto Rico. *a*, *b*, opposite sides; *c*, apertural view.

2. *Quinqueloculina poeyana* d'Orbigny. × 90. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

3. *Quinqueloculina subpoeyana* Cushman. × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

4. *Quinqueloculina disparilis* d'Orbigny. × 80. Off Plymouth, England. *a*, *b*, opposite sides; *c*, apertural view.

5–7. *Quinqueloculina bicornis* (Walker and Jacob). After Williamson. *a*, *b*, opposite sides; *c*, apertural view. Figs. 6, 7, Early stages.



MILIOLIDAE OF THE ATLANTIC OCEAN

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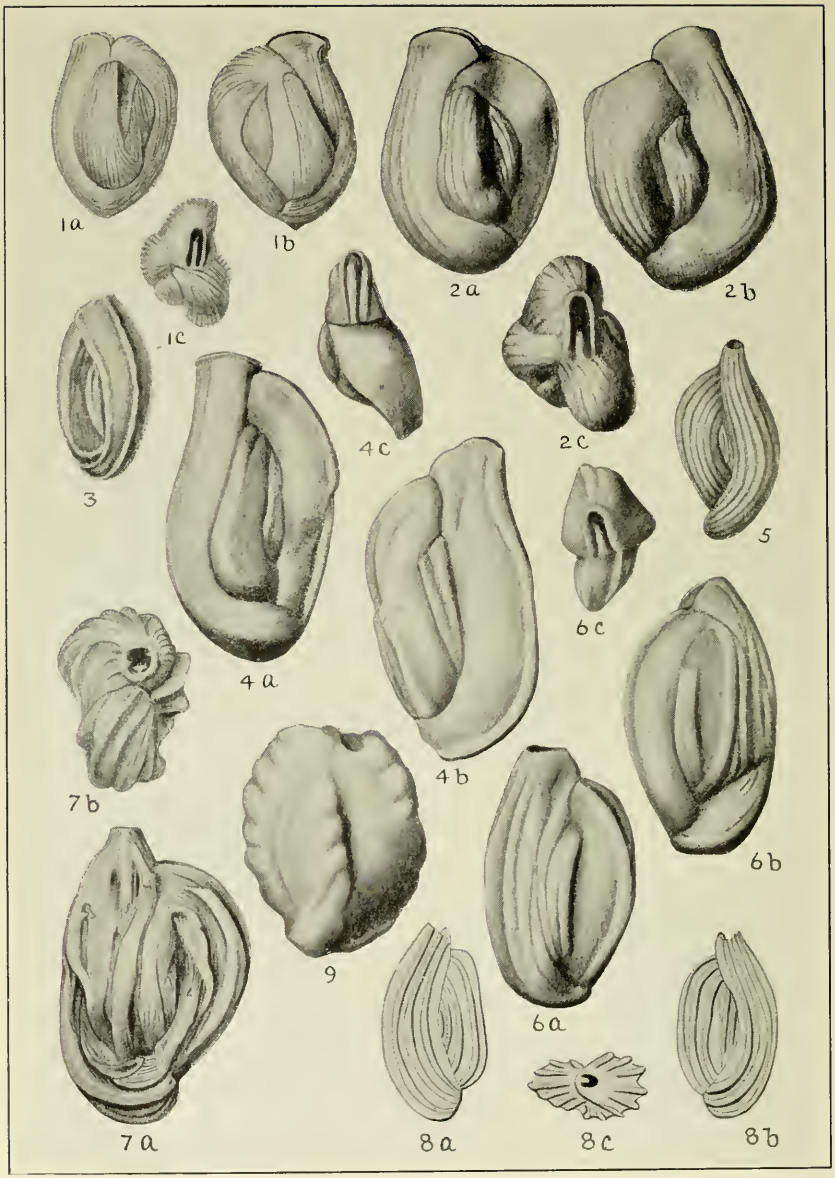


MILIOLIDAE OF THE ATLANTIC OCEAN

FOR EXPLANATION OF PLATE SEE PAGE 107

Plate 6

Figure 1. *Quinqueloculina bicornis* (Walker and Jacob). × 32. After H. B Brady. *a*, *b*, opposite sides; *c*, apertural view.

2. *Quinqueloculina bicornis* (Walker and Jacob). × 80. From *Lord Bandon*, log. 33. off S. W. Ireland. *a*, *b*, opposite sides; *c*, apertural view.

3. *Quinqueloculina bicornis* (Walker and Jacob), var. *angulata* Williamson. After Williamson.

4. *Quinqueloculina bicornis* (Walker and Jacob), var. *angulata* Williamson. From *Lord Bandon*, log. 33, off S. W. Ireland. *a*, *b*, opposite sides; *c*, apertural view.

5. *Quinqueloculina bicornis* (Walker and Jacob), var. *elegans* Williamson. After Williamson.

6. *Quinqueloculina seminuda* Reuss. × 80. Off Plymouth, England. *a*, *b*, opposite sides; *c*, apertural view.

7. *Quinqueloculina pulchella* d'Orbigny. × 20. After H. B. Brady. *a*, side view; *b*, apertural view.

8. *Quinqueloculina pulchella* d'Orbigny. From "planches inédités" of d'Orbigny. After Fornasini.

9. *Quinqueloculina parkeri* H. B. Brady, var. *occidentalis* Cushman. × 80.

Plate 7

Figure 1. *Quinqueloculina* cf. *kerimbatica* (Heron-Allen and Earland). × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

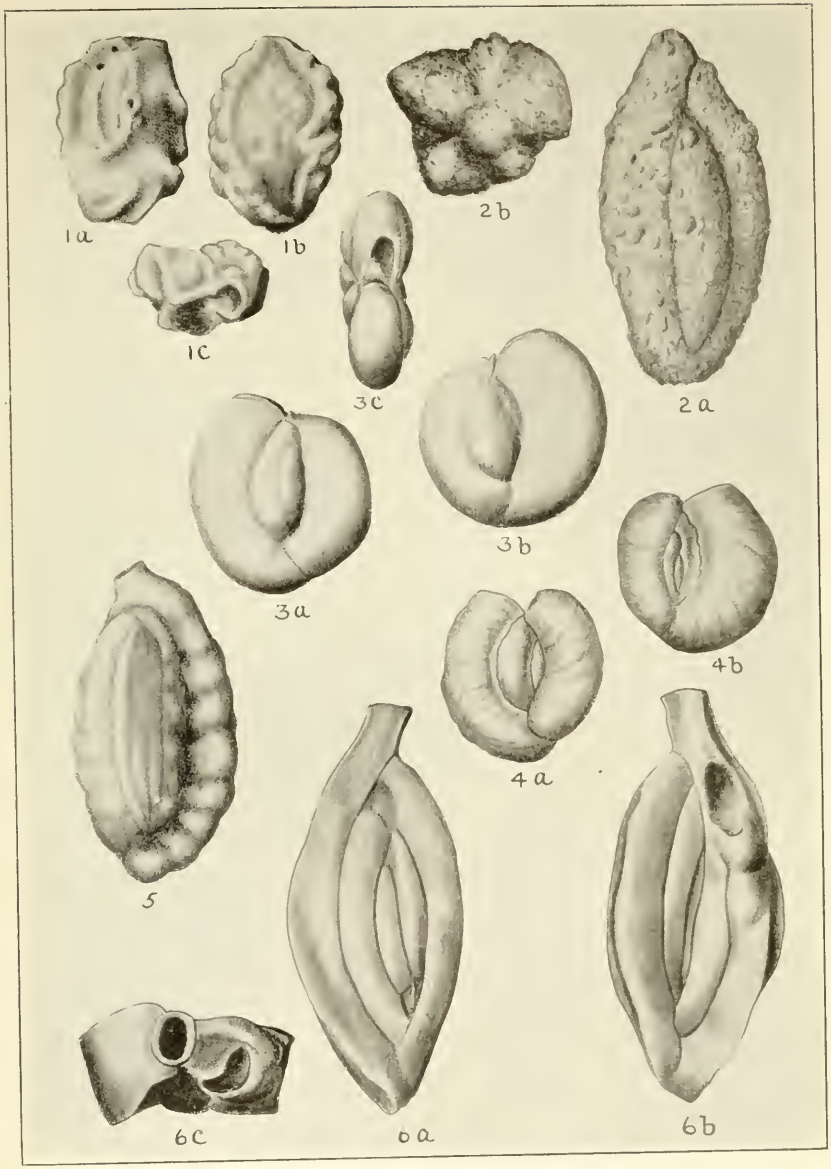
2. *Schlumbergerina alveoliniformis* (H. B. Brady), var. *occidentalis* Cushman, new variety. × 40. Tortugas. *a*, side view; *b*, apertural view.

3. *Massilina secans* (d'Orbigny). × 60. Dogs Bay, Ireland. *a*, *b*, opposite sides; *c*, apertural view.

4. *Massilina secans* (d'Orbigny). After Williamson. *a*, *b*, opposite sides.

5. *Massilina crenata* Karrer. × 80. Tortugas.

6. *Massilina inaequalis* Cushman. × 60. Montego Bay, Jamaica. *a*, *b*, opposite sides; *c*, apertural view.



MILIOLIDAE OF THE ATLANTIC OCEAN

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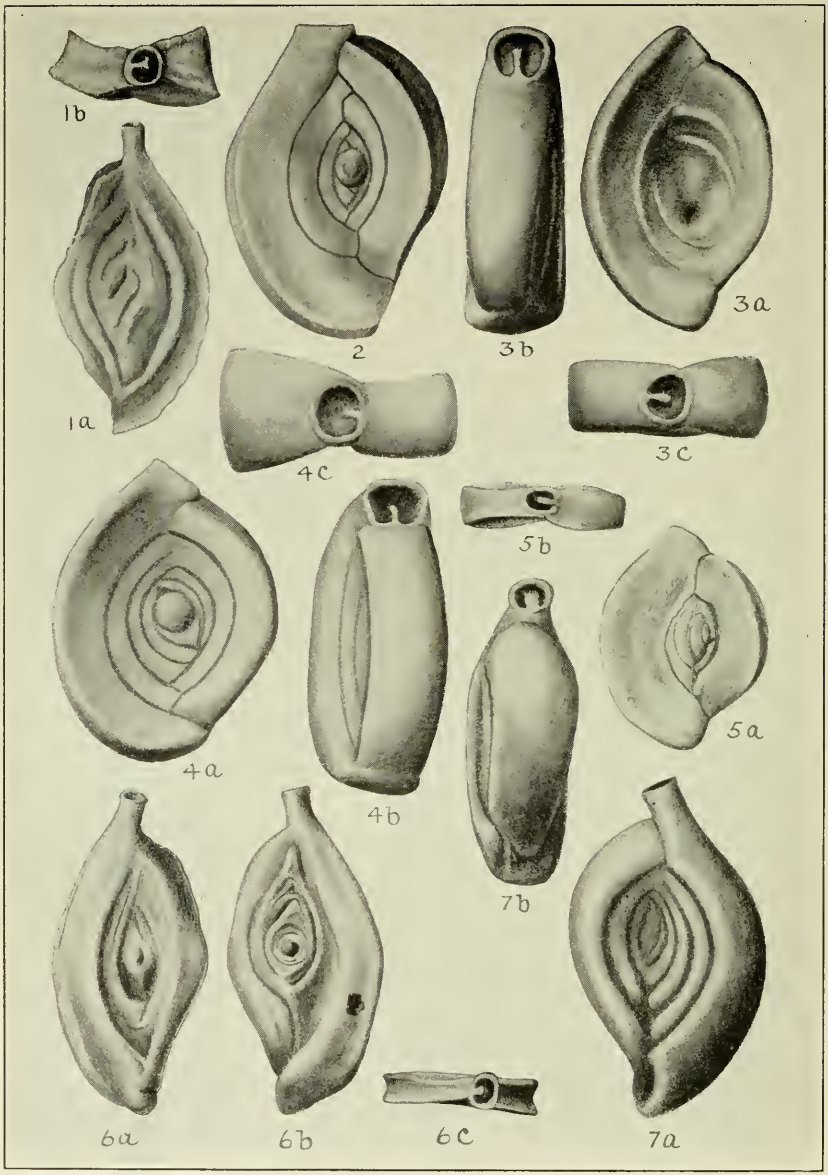

MILIOLIDAE OF THE ATLANTIC OCEAN

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Plate 8

Figure 1. *Spiroloculina grateloupi* d'Orbigny. × 60. Tortugas. *a*, front view; *b*, apertural view.

2. *Spiroloculina planulata* (Lamarck). × 40. Tortugas.

3. *Spiroloculina planulata* (Lamarck). × 40. *Flying Fox*, log. 8, off S. W. Ireland. *a*, front view; *b*, side view; *c*, apertural view.

4. *Spiroloculina planulata* (Lamarck). × 40. *Lord Bandon*, log. 33, off S. W. Ireland. *a*, front view; *b*, side view; *c*, apertural view.

5. *Spiroloculina planulata* (Lamarck). × 28. After H. B. Brady. *a*, front view; *b*, apertural view.

6. *Spiroloculina ornata* d'Orbigny. × 50. Tortugas. *a*, *b*, opposite faces; *c*, apertural view.

7. *Spiroloculina eximia* Cushman. × 100. Tortugas. *a*, front view; *b*, side view.

Plate 9

Figures 1, 2. *Spiroloculina caduca* Cushman. × 60. Tortugas. *a*, front view; *b*, apertural view.

3. *Spiroloculina antillarum* d'Orbigny. × 50. Tortugas. *a*, front view; *b*, apertural view.

4. *Spiroloculina antillarum* d'Orbigny, var. *angulata* Cushman. × 50. Tortugas. *a*, front view; *b*, apertural view.

5. *Spiroloculina arenata* Cushman. × 60. Tortugas. *a*, front view; *b*, apertural view.

6. *Spiroloculina limbata* d'Orbigny. After Williamson.

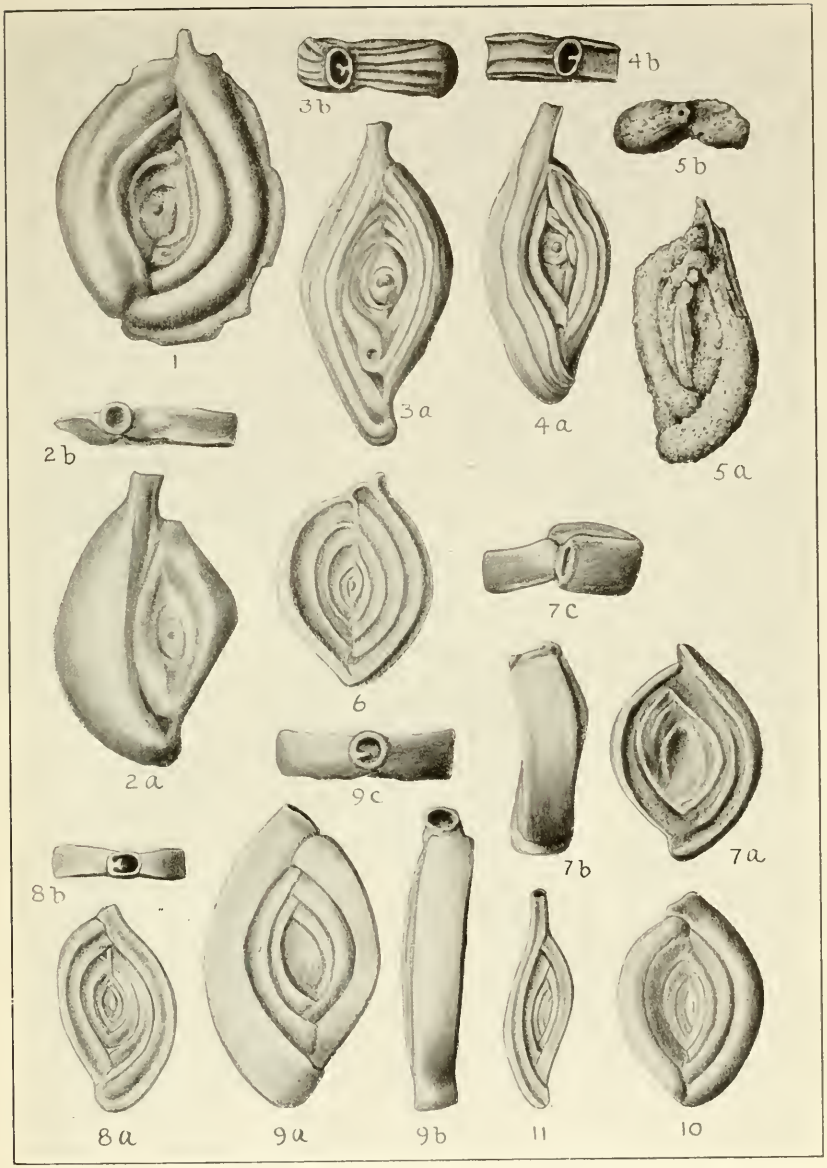
7. *Spiroloculina limbata* d'Orbigny. × 40. From *Lord Bandon*, log. 42, off S. W. Ireland. *a*, front view; *b*, side view; *c*, apertural view.

8. *Spiroloculina depressa* d'Orbigny. × 24. After H. B. Brady. *a*, front view; *b*, apertural view.

9. *Spiroloculina depressa* d'Orbigny. × 40. Off Plymouth, England. *a*, front view; *b*, side view; *c*, apertural view.

10. *Spiroloculina depressa* d'Orbigny, var. *rotundata* Williamson. After Williamson.

11. *Spiroloculina depressa* d'Orbigny, var. *cymbia* Williamson. After Williamson.



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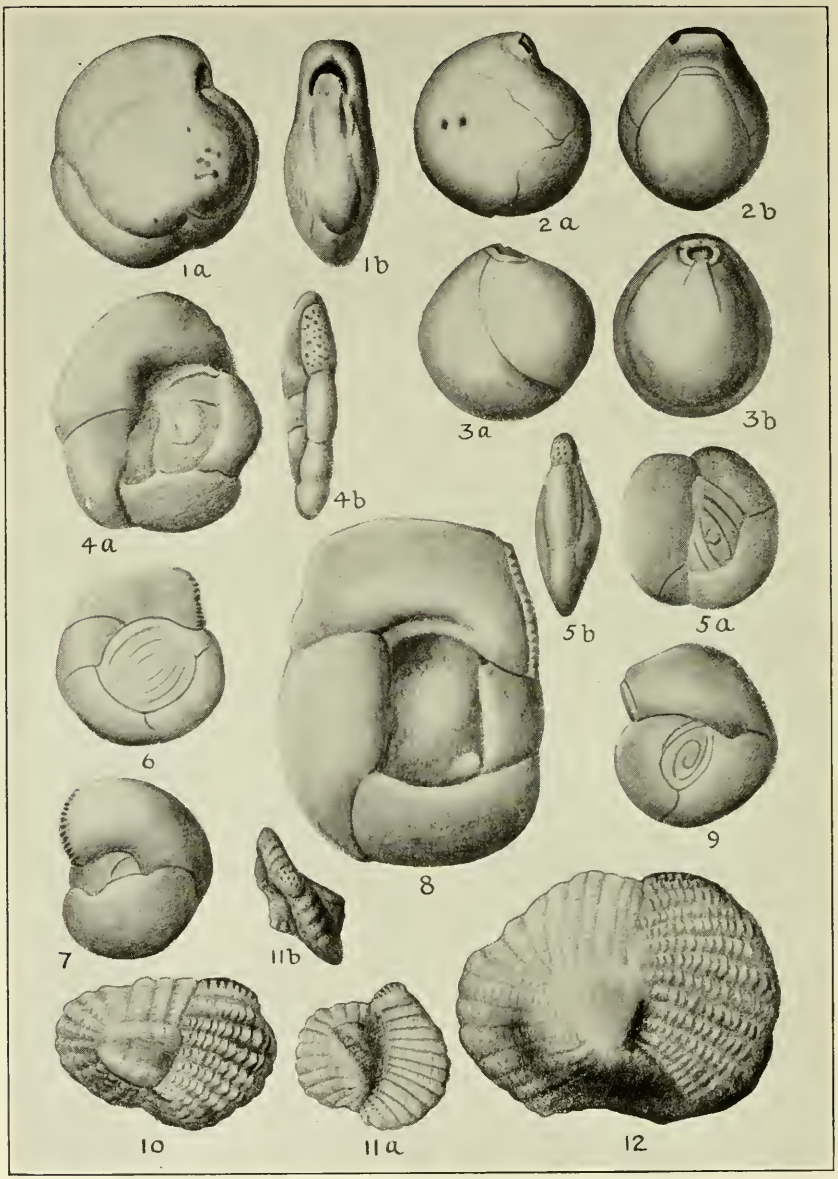

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Plate 10

Figure 1. *Nummoloculina contraria* (d'Orbigny). × 12. After H. B. Brady. *a*, side view; *b*, apertural view.

2, 3. *Nummoloculina irregularis* (d'Orbigny). After H. B. Brady. Fig. 2, ×16. Fig. 3, ×24.

4–9. *Hauerina bradyi* Cushman. × 60. Figs. 4, 8, Porto Rico. Figs. 5, 6, 9, Tortugas. Fig. 7, Montego Bay, Jamaica. *a*, side view; *b*, apertural view.

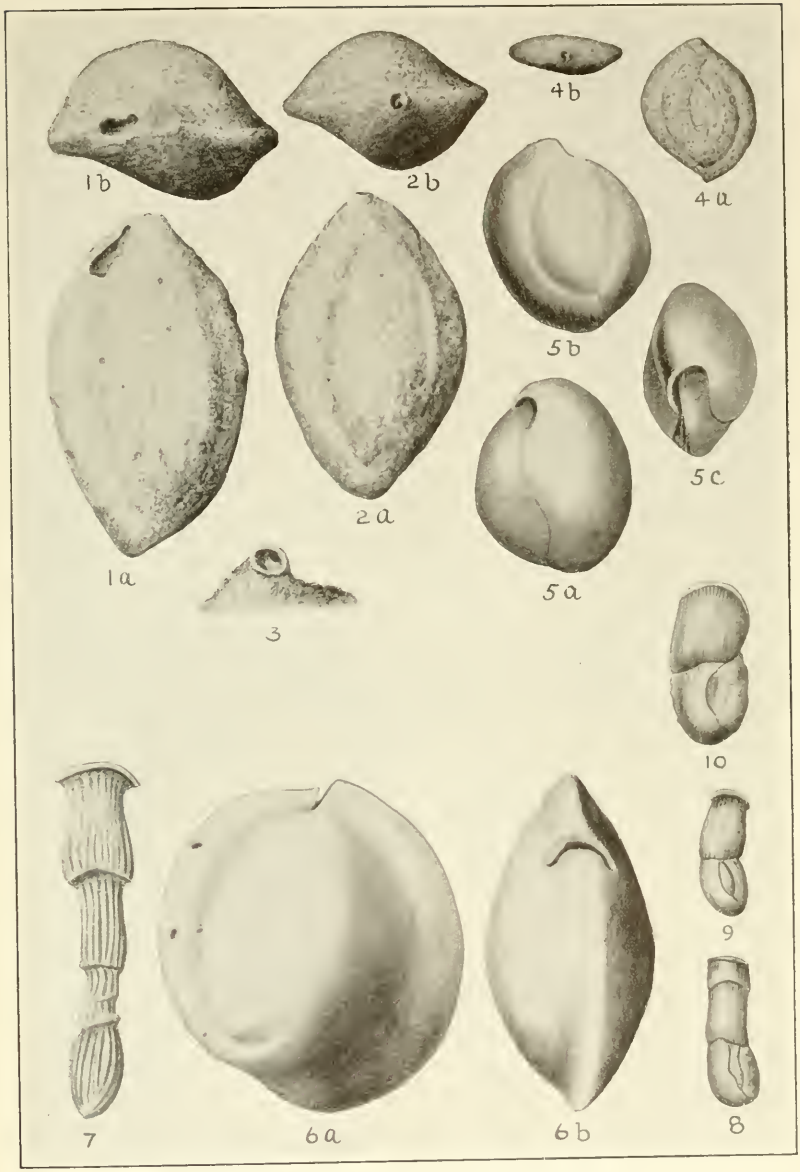
10–12. *Hauerina ornatissima* Karrer. × 60. Tortugas. *a*, side view; *b*, apertural view.

Plate 11

Figures 1–3. *Sigmoilina schlumbergeri* A Silvestri. Figs 1, 2, × 80. Fig. 3, × 90. 1. From off S. W. Ireland, 620–695 fathoms. Fig. 2, same. 1,000 fathoms. 3. From *Albatross* Station 2377, Gulf of Mexico.

4. *Sigmoilina asperula* (Karrer). *a*, side view; *b*, apertural view.
5. *Sigmoilina sigmoidea* (H. B. Brady). × 90. After Heron-Allen and Earland. *a*, *b*, opposite sides; *c*, apertural view.
6. *Sigmoilina sigmoidea* (H. B. Brady). × 60. *Albatross* D 2117. *a*, side view; *b*, apertural view.
7. *Articulina sagra* d'Orbigny. × 60. Tortugas.

8–10. *Articulina lineata* H. B. Brady. × 40. After H. B. Brady.



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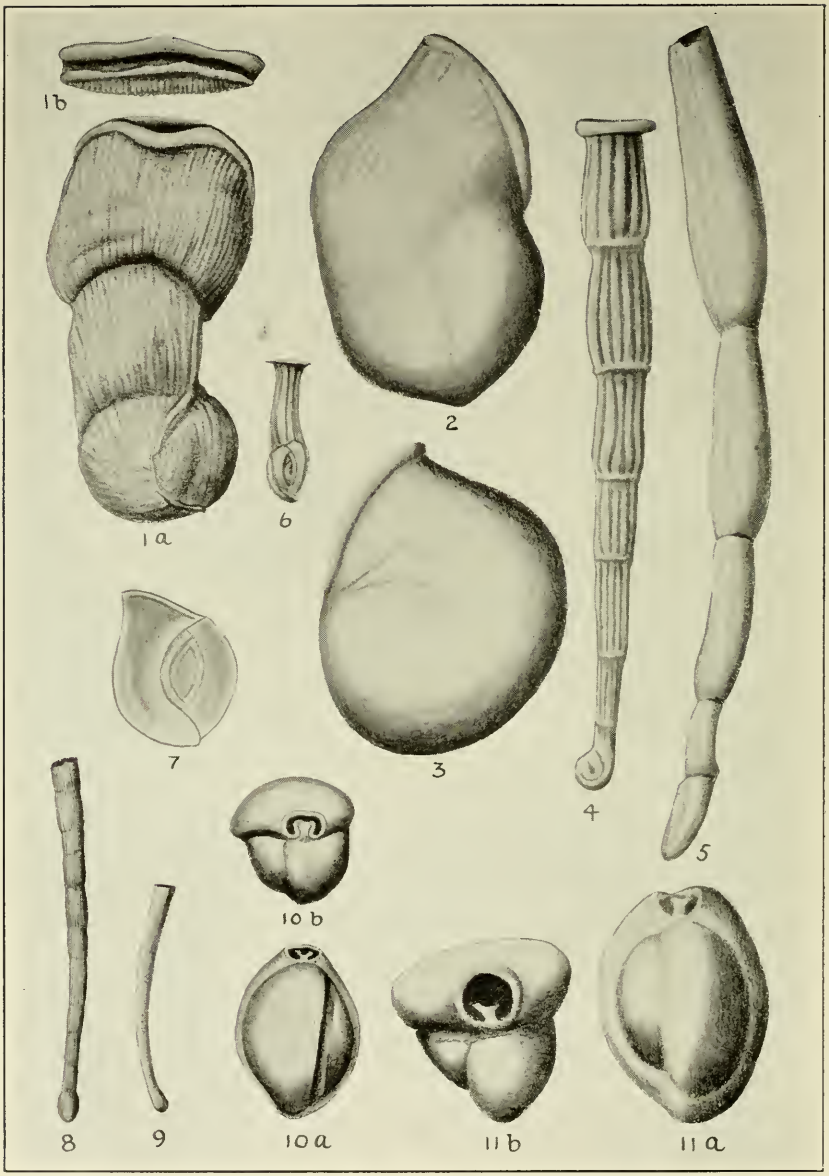

MILIOLIDAE OF THE ATLANTIC OCEAN

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Plate 12

Figure 1. *Articulina lineata* H. B. Brady. × 65. Tortugas. *a*, side view; *b*, apertural view.

2, 3. *Articulina mexicana* Cushman. × 60. Tortugas.

4. *Articulina antillarum* Cushman. × 40. Tortugas.

5. *Articulina mayori* Cushman. × 80. Tortugas.

6. *Articulina sulcata* Reuss. × 40. After H. B. Brady.

7. *Articulina multilocularis* H. B. Brady, Parker, and Jones. After type figure.

8. *Tubinella funalis* (H. B. Brady). × 24. After H. B. Brady.

9. *Tubinella funalis* (H. B. Brady), var. *inornata* (H. B. Brrady). × 32. After H. B. Brady.

10. *Triloculina trigonula* (Lamarck). × 32. After H. B. Brady. *a*, side view; *b*, apertural view.

11. *Triloculina trigonula* (Lamarck). × 60. San Juan Harbor Porto Rico. *a*, side view; *b*, apertural view.

Plate 13

Figure 1. *Triloculina trigonula* (Lamarck). × 50. From *Lord Bandon*, log. 42, off S. W. Ireland. *a*, *b*, opposite sides; *c*, apertural view.

2. *Triloculina trigonula* (Lamarck). After Williamson. *a*, *b*, opposite sides; *c*, apertural view.

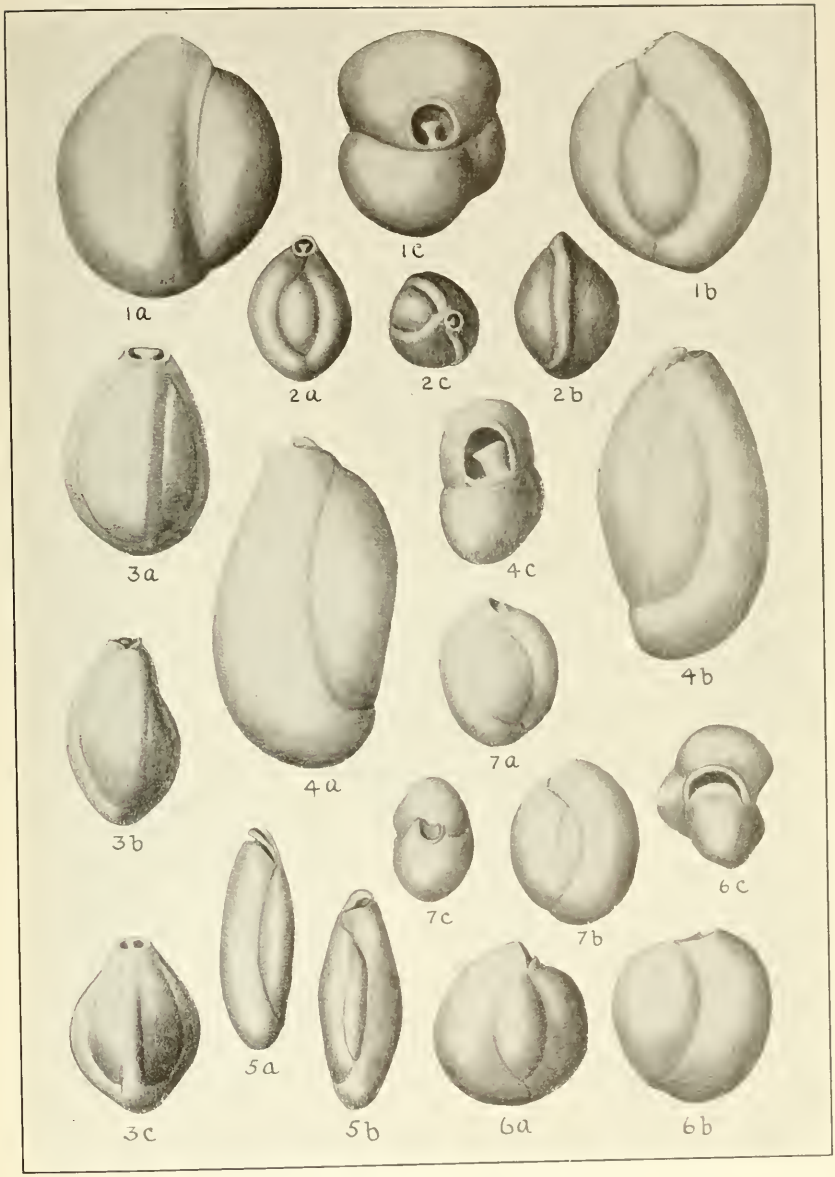
3. *Triloculina tricarinata* d'Orbigny. × 40. Tortugas. *a-c*, side views.

4. *Triloculina oblonga* d'Orbigny. × 60. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

5. *Triloculina oblonga* d'Orbigny. After Williamson. *a*, *b*, opposite sides.

6. *Triloculina circularis* Bornemann. × 40. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

7. *Triloculina circularis* Bornemann. × 40. Dogs Bay, Ireland. *a*, *b*, opposite sides; *c*, apertural view.



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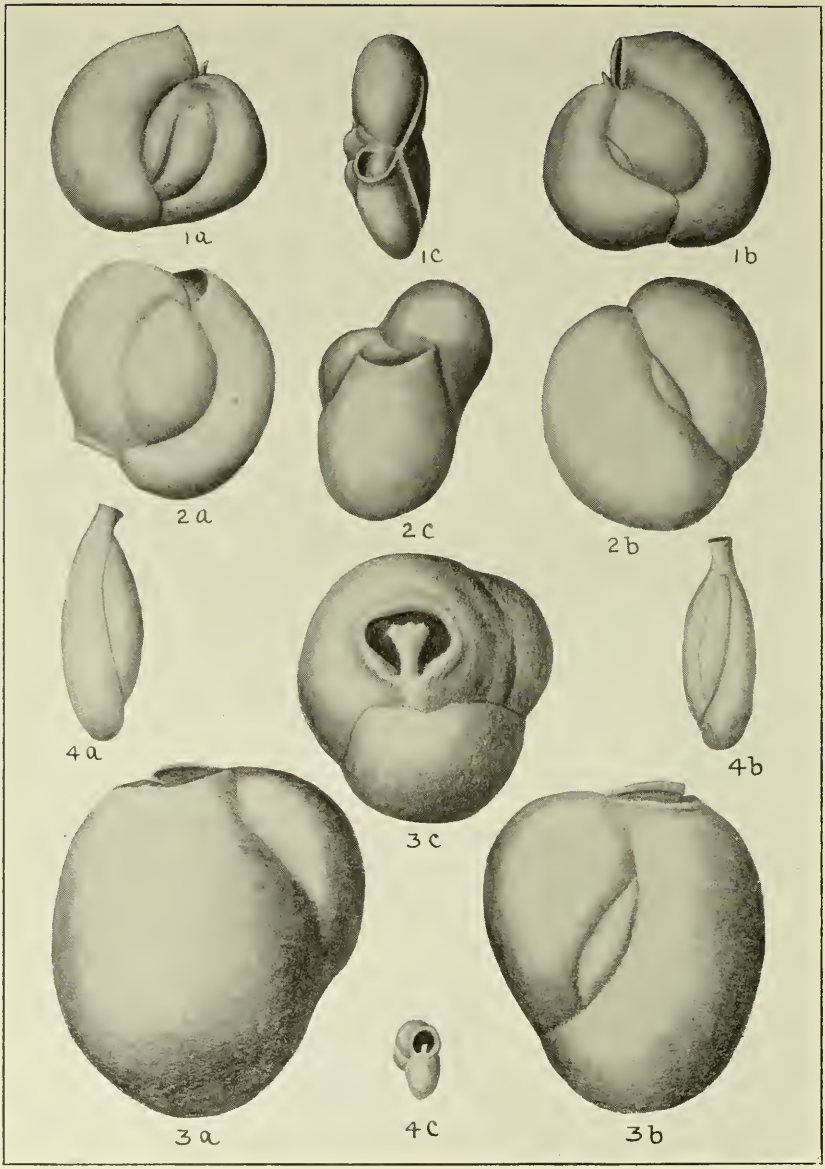

MILIOLIDAE OF THE ATLANTIC OCEAN

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Plate 14

Figures 1, 2. *Triloculina circularis* Bornemann. × 40. Dogs Bay, Ireland. *a*, *b*, opposite sides; *c*, apertural view.

3. *Triloculina rotunda* d'Orbigny. × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

4. *Triloculina gracilis* d'Orbigny. × 80. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

Plate 15

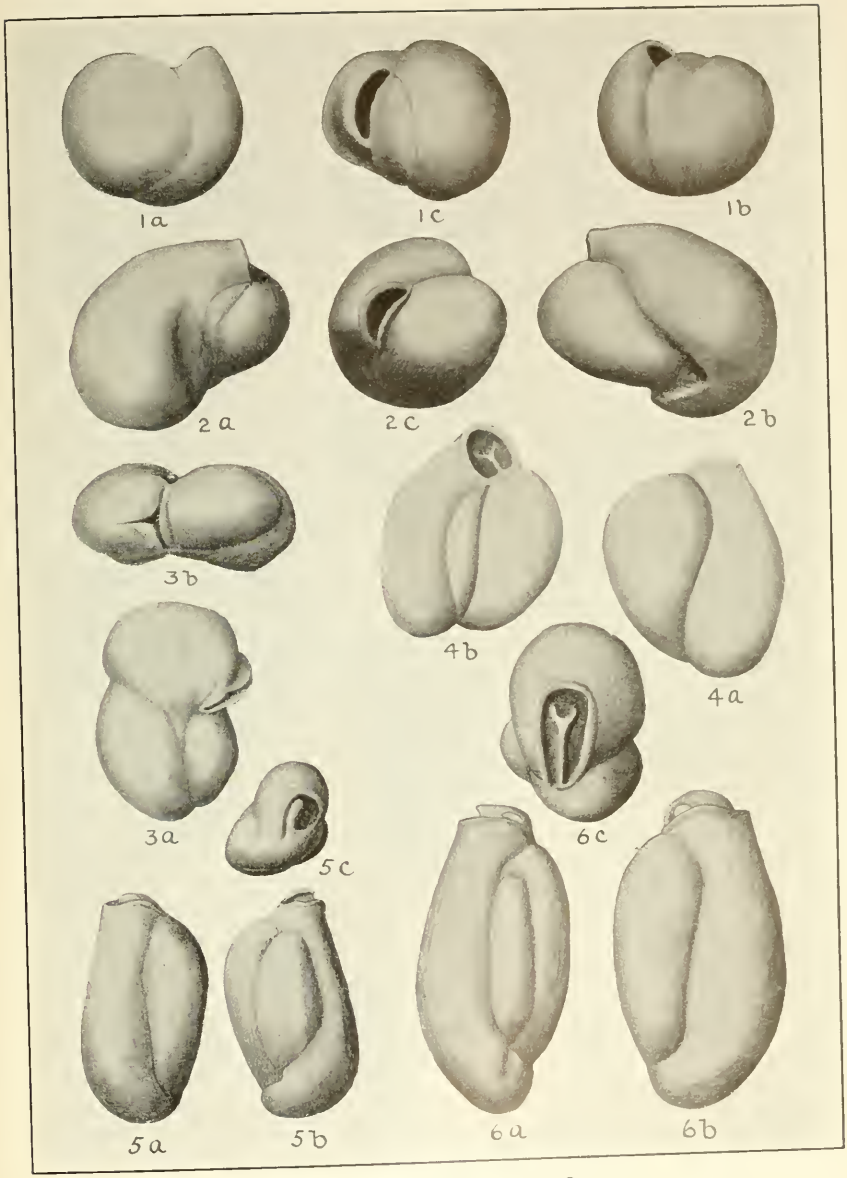
Figure 1. *Triloculina bucculenta* (H. B. Brady). × 40. After Heron-Allen and Earland. *a*, *b*, opposite sides; *c*, apertural view.

2. *Triloculina labiosa* d'Orbigny (?). × 50. *Lord Bandon*, log. 33, off S. W. Ireland. *a*, *b*, opposite sides; *c*, apertural view.

3. *Triloculina labiosa* d'Orbigny. × 60. Tortugas. *a*, side view; *b*, apertural view.

4. *Triloculina anconensis* Schultze. After type figure.

5, 6. *Triloculina planciana* d'Orbigny. × 80. 5. Tortugas. 6. San Juan Harbor, Porto Rico. *a*, *b*, opposite sides; *c*, apertural view.



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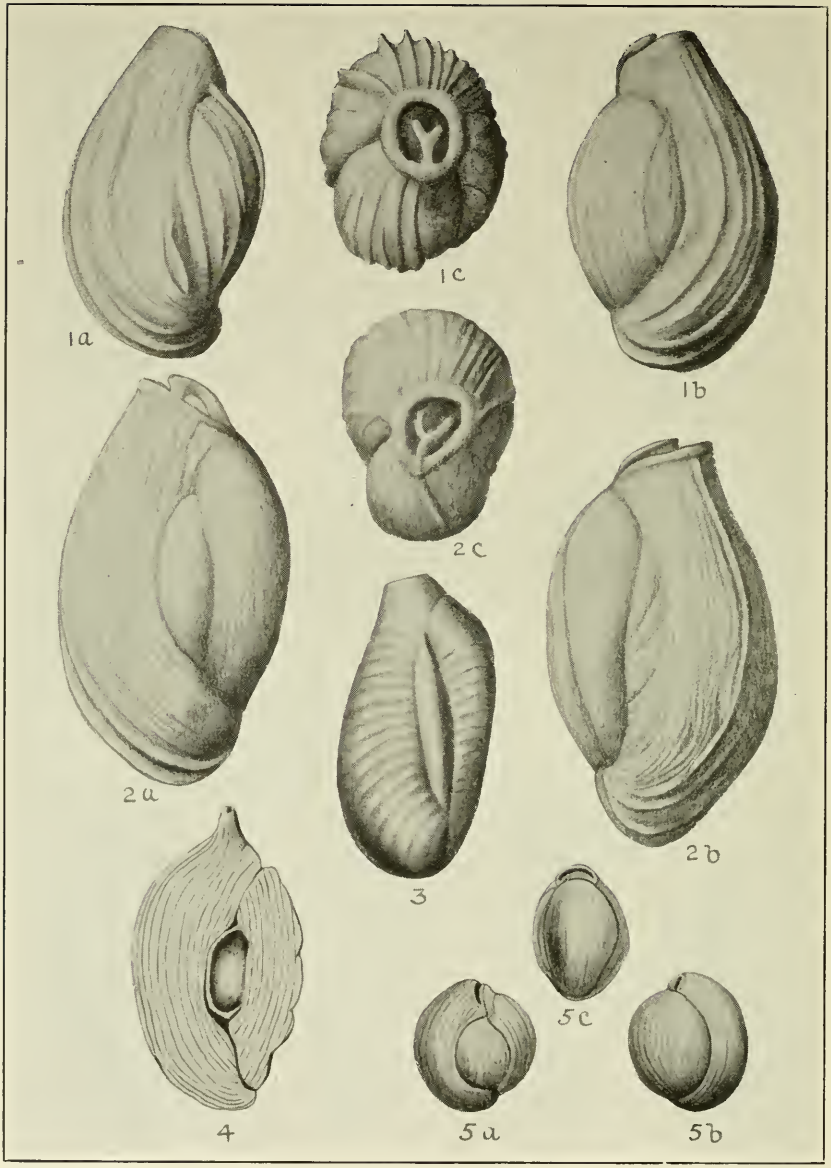

MILIOLIDAE OF THE ATLANTIC OCEAN

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Plate 16

Figures 1, 2. *Triloculina linneiana* d'Orbigny. × 40. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

3. *Triloculina transverscstriata* (H. B. Brady). × 80. Tortugas.

4. *Triloculina bronguiartii* d'Orbigny. After Parker, Jones, and H. B. Brady. From Soldani.

5. *Triloculina suborbicularis* d'Orbigny. × 50. After Heron-Allen and Earland. *a*, *b*, opposite sides; *c*, apertural view.

PLATE 17

FIGURE 1. *Triloculina fichtelliana* d'Orbigny. × 50. Tortugas. *a*, *b*, opposite sides; *c*, apertural view.

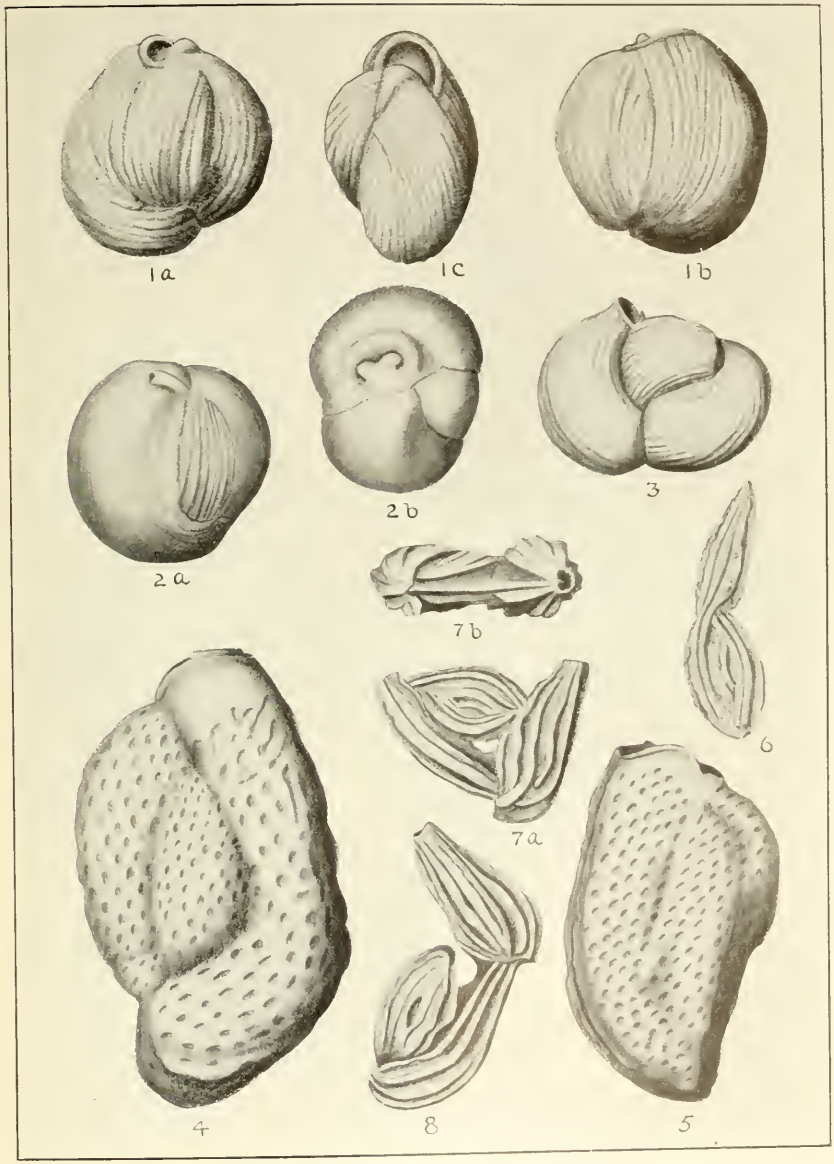
2. *Triloculina insignis* (H. B. Brady). × 22. After H. B. Brady. *a*, side view; *b*, apertural view.

3. *Triloculina suborbicularis* d'Orbigny. × 60. Jamaica.

4. *Triloculina carinata* d'Orbigny. × 60. Tortugas.

5. *Triloculina bicarinata* d'Orbigny. × 40. Tortugas.

6–8. *Ptychomiliola separans* (H. B. Brady). After H. B. Brady. *a*, side view; *b*, apertural view.



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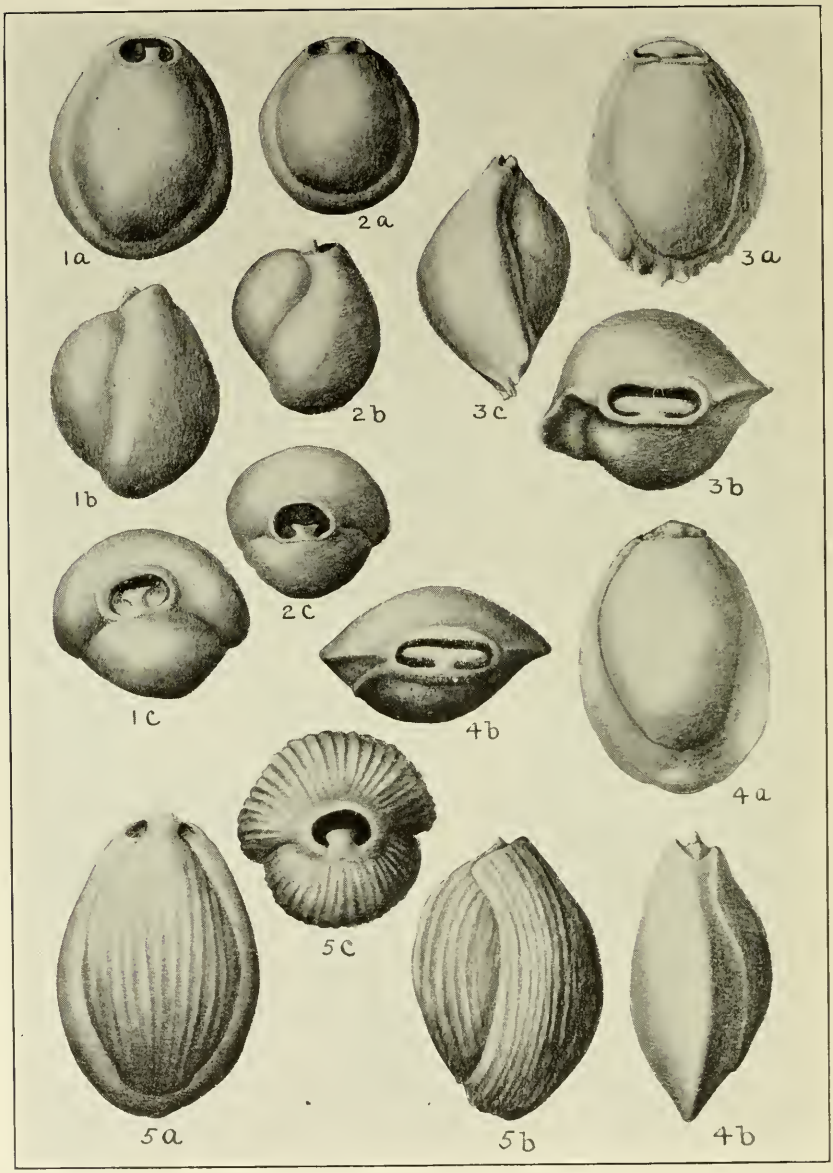

MILIOLIDAE OF THE ATLANTIC OCEAN

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Plate 18

Figure 1, 2. *Pyrgo subsphaerica* (d'Orbigny). × 80. 1. Tortugas. 2. San Juan Harbor, Porto Rico. *a*, front view; *b*, side view; *c*, apertural view.

3, 4. *Pyrgo denticulata* (H. B. Brady). × 40. 3. Montego Bay, Jamaica. 4. Tortugas. *a*, front view; *b*, side view; *c*, apertural view.

5. *Pyrgo denticulata* (H. B. Brady), var. *striolata* (H. B. Brady). × 40. Tortugas. *a*, front view; *b*, side view; *c*, apertural view.

PLATE 19

FIGURE 1. *Pyrgo millettii* Cushman. × 60. Tortugas.

2. *Pyrgo elongata* (d'Orbigny). × 60. *Lord Bandon*, log. 42, off S. W. Ireland. *a*, front view; *b*, side view; *c*, apertural view.

3. *Pyrgo elongata* (d'Orbigny). × 36. After H. B. Brady. *a*, front view, *b*, apertural view.

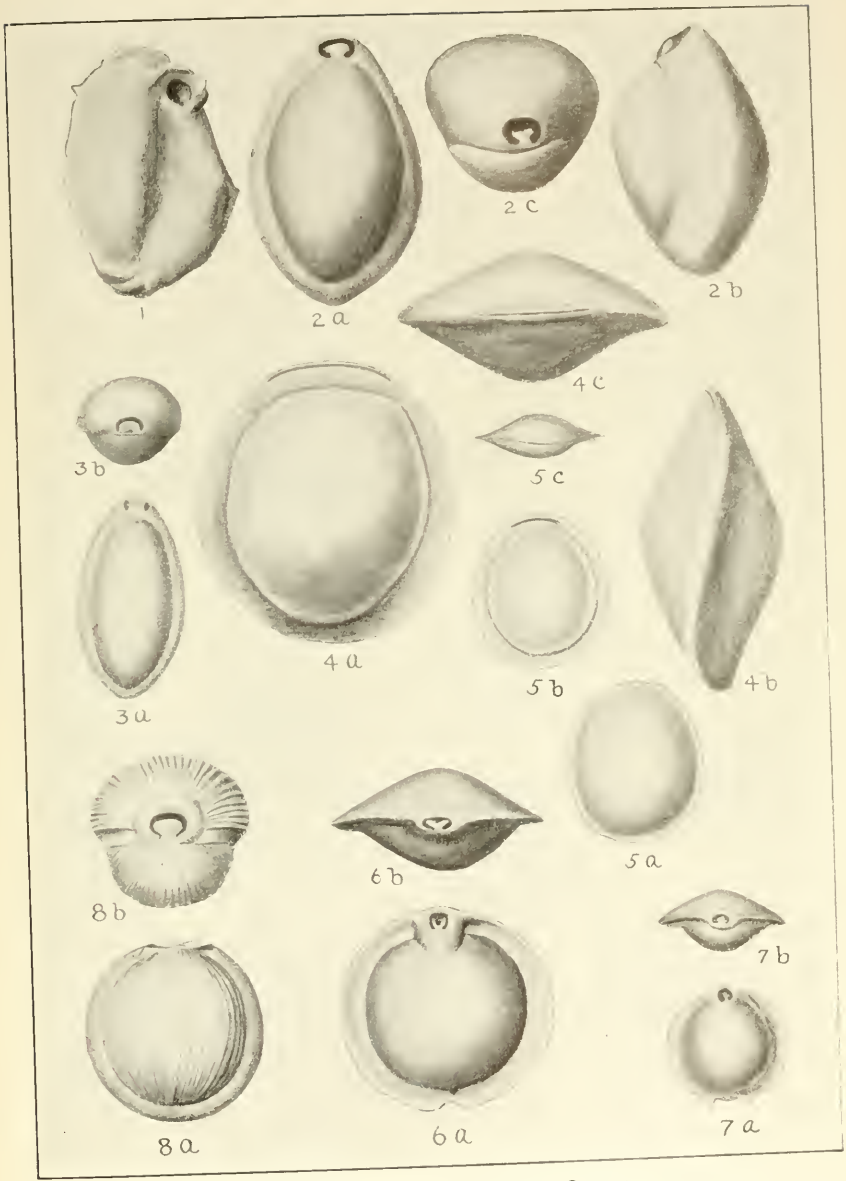
4. *Pyrgo depressa* (d'Orbigny). × 40. *Lord Bandon*, log. 42, off S. W. Ireland. *a*, front view; *b*, side view; *c*, apertural view.

5. *Pyrgo depressa* (d'Orbigny). After Williamson.

6. *Pyrgo murrhina* (Schwager). × 32. After H. B. Brady.

7. *Pyrgo murrhina* (Schwager). × 40. After H. B. Brady.

8. *Pyrgo comata* (H. B. Brady). × 32. After H. B. Brady.



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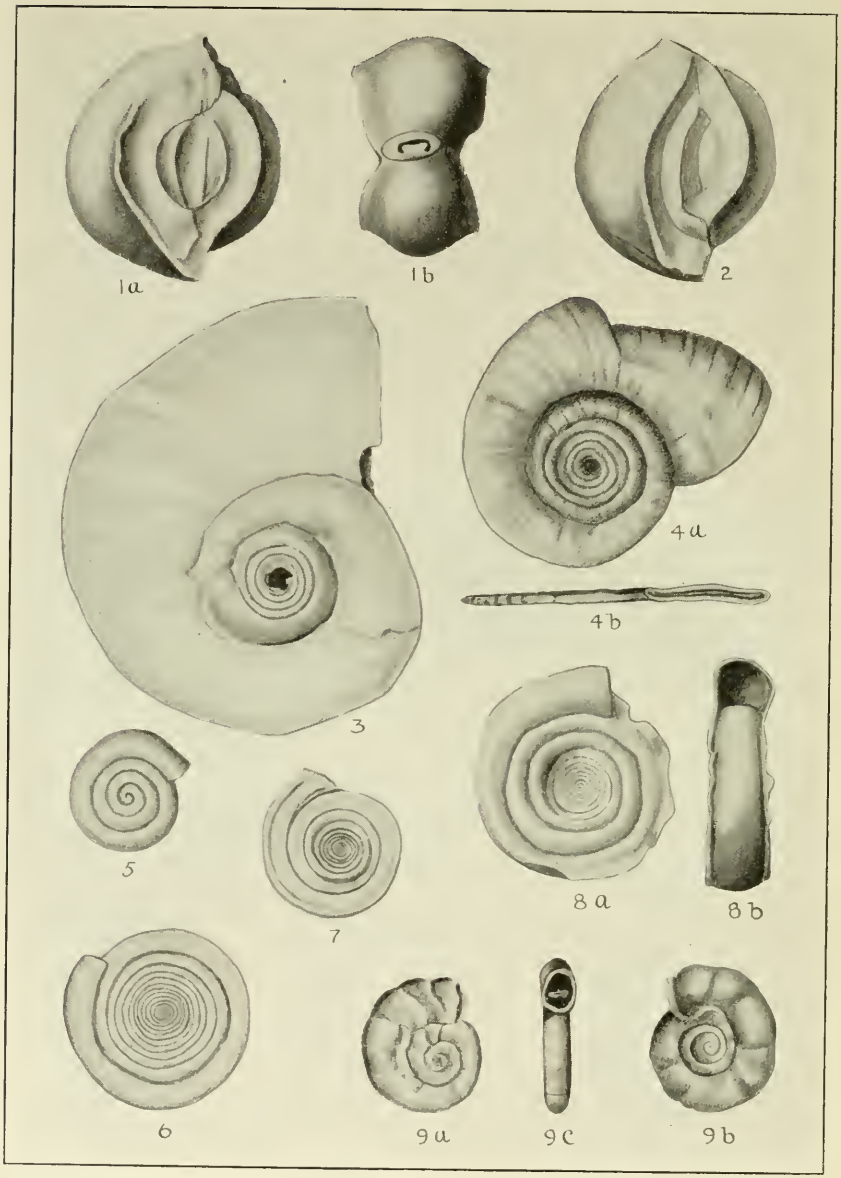

MILIOLIDAE, OPHTHALMIDIIDAE AND FISCHERINIDAE OF THE ATLANTIC OCEAN

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Plate 20

Figures 1, 2. *Flintia robusta* (H. B. Brady). × 16. After H. B. Brady. *a*, side view; *b*, apertural view.

3–5. *Cornuspira foliacea* (Philippi). 3. × 25. *Albatross* D 2072. 4, 5. After Williamson. *a*, side view; *b*, apertural view. 5. Young.

6. *Cornuspira involvens* (Reuss). × 24. After H. B. Brady.

7. *Cornuspira carinata* Costa. × 24. After H. B. Brady.

8. *Cornuspira involvens* (Reuss). × 30. Tortugas.

9. *Cornuspira selseyensis* Heron-Allen and Earland. After type specimen.

Plate 21

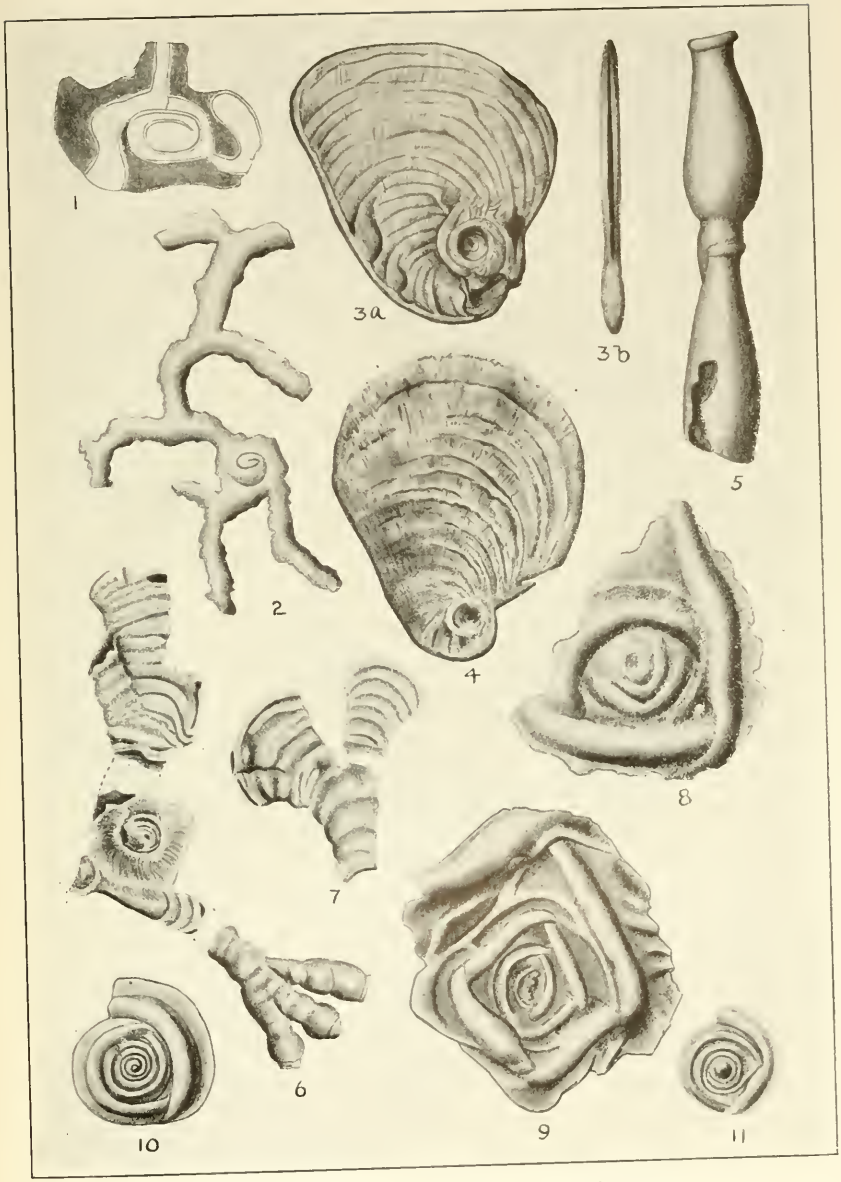
Figures 1, 2. *Cornuspiramia antillarum* (Cushman). Tortugas. 1. Central part from below; 2, dorsal surface.

3, 4. *Cornuspiroides striolata* (H. B. Brady). 3. × 5. after H. B. Brady, *a*, side view; *b*, peripheral view. 4. After Heron-Allen and Earland. × 3.

5. *Nodobacularia tibia* (Jones and Parker). × 80. Tortugas.

6, 7. *Cornuspirella diffusa* (Heron-Allen and Earland). × 16. After Heron-Allen and Earland.

8–11. *Ophthalmidium inconstans* H. B. Brady. × 24. After H. B. Brady.



OPHTHALMIDIIDAE OF THE ATLANTIC OCEAN

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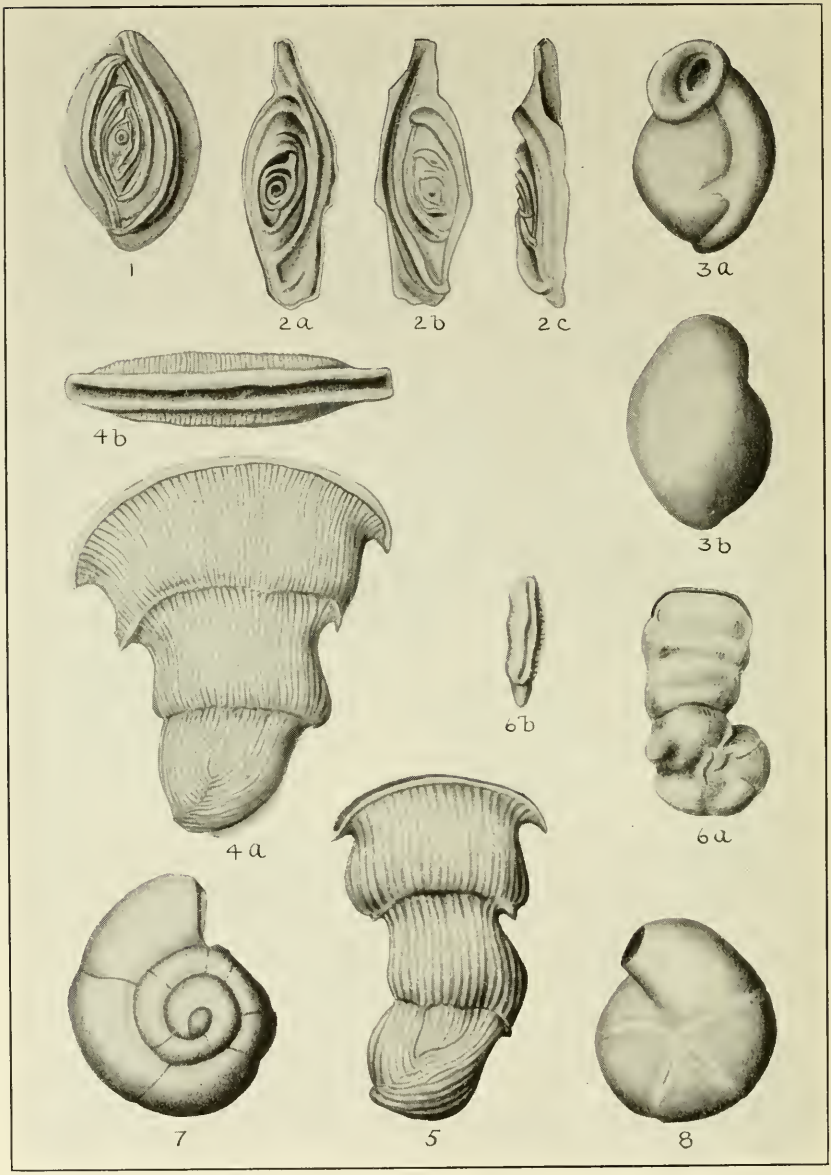

OPHTHALMIDIIDAE AND FISCHERINIDAE OF THE ATLANTIC OCEAN

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Plate 22

Figure 1. *Spiropthalmidium acutimargo* (H. B. Brady). × 40. After H. B. Brady.

2. *Spiropthalmidium acutimargo* (H. B. Brady), var. *concava* (Wiesner). × 90. After Heron-Allen and Earland. *a*, *b*, opposite sides; *c*, peripheral view.

3. *Planispirina auriculata* Egger. × 90. Tortugas. *a*, *b*, opposite sides.

4. *Vertebralina cassis* d'Orbigny. × 50. Montego Bay, Jamaica. *a*, side view; *b*, apertural view.

5. *Vertebralina cassis* d'Orbigny, var. *mucronata* d'Orbigny. × 80. Tortugas.

6. *Vertebralina striata* d'Orbigny. After Williamson. *a*, front view; *b*, apertural view.

7, 8. *Fischerina dubia* (d'Orbigny). × 80. Tortugas. 7. dorsal view; 8. ventral view of another specimen.

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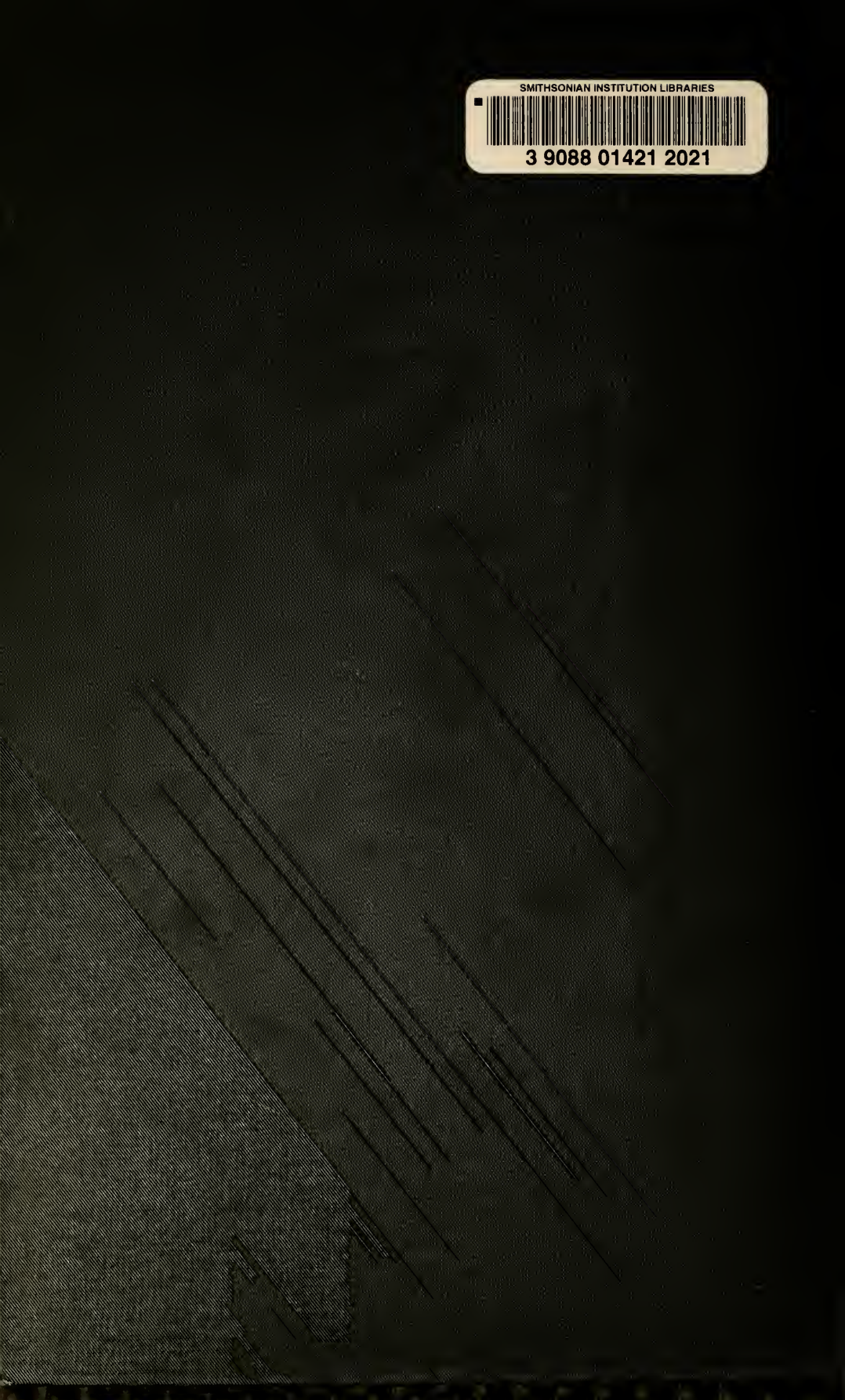
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